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TRAVELS

THROUGH THE

BANNAT

OF

TEMESWAR,

TRANSYLVANIA,

AND

HUNGARY,

In the Year 1770.

DESCRIBED IN

A SERIES of LETTERS to PROF. FERBER,

ON THE

MINES and MOUNTAINS

Of these different Countries,

By BARON INIGO BORN,

Counsellor of the ROYAL MINES, in Bohemia.

To which is added,

JOHN JAMES FERBER'S

MINERALOGICAL HISTORY of BOHEMIA.

TRANSLATED from the GERMAN,

With some explanatory Notes, and a Preface on the Mechanical Arts, the Art of Mining, and its present State and future Improvement,

By R. E. RASPE.

In nova fert animus mutatas dicere formas.

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MDCCLXXVII.

PREFACE.

HAVING introduced Mr. Ferber's accounts of Italy, with ſome general views of thoſe parts of Mineralogy, which have of late been improved, and may be further by a nearer examination of the Volcanoes and their various productions; it is but juſt that theſe accounts of the Hungarian and Bohemian mines ſhould be accompanied with ſimilar views on the art of mining; the nature of the different metallic mountains *and of their various veins and productions.*

This ſcience has been the ſcience of riches ever ſince the uſe of metals and of other foſſils have been diſcovered, and turned to account by mankind. Though that diſcovery be a very old one, and the art of mining and of ſmelting be handed down to us by a long ſeries of ages, and by different nations, ſome

of its ſcientifical parts are, however, brought to a leſs certainty than we might have expected.

Was it, that

Mammon, the leaſt erected ſpirit, that fell
From Heaven,

was leſs adored, and his worſhip leſs followed than that of the fairer Muſes? Was it

That riches grow in Hell, that ſoil which beſt
Deſerves the precious bane?

Indeed it was not; for gold and ſilver, and riches have been in every age, in every clime, adored and purſued by all the nations, which had any claim to ingenuity, with ſuch a zealous eagerneſs as would have done credit to any divinity. It is the common fate of the moſt uſeful and practical arts, to have been, in every age and in every nation, left in a ſtate of infancy, and in the hands of working people, or of impoſing quacks. Sovereigns have encouraged, and the wiſe and learned, with preſumptuous attempts, purſued hazardous flights into the lofty regions of ſcholaſtic divinity and metaphyſicks, beyond the reach of human abilities, and aimed at ſuch objects, which in this world do not make us either wiſer or happier, or richer or better. It is a very ſingular phænomenon in the hiſtory of mankind, that the arts of fortune-telling, of rhiming, of ſinging, fidling, reaſoning, and ſpeaking, ſhould have been reduced

into

ſcientifical forms; nay, that they ſhould have been ſo highly improved, before any friend of men and good-ſenſe thought of reducing the better arts of huſbandry, of phyſic, of navigation, and of mining into the forms of ſciences; of fixing them for ever, and of eſtabliſhing them upon the evident and conſtant principles of nature. But ſuch is the perverſeneſs of human nature! Wants and accidents have co-operated to invent and to introduce the uſeful arts by the ſkill and ingenuity of ſome men, whom the Savages in the infant ſtate of ſociety have juſtly revered as their greateſt benefactors, and as ſuch have ranked and forgot them in the croud of their heroes and divinities. Ceres and Triptolemus, Pomona, Minerva and Eſculapius, for being the inventors, improvers, or introducers of huſbandry, gardening, weaving, and phyſic, have been by the ſavage Greeks, Tuſcans, or Latins, conſecrated to poſterity by the ſame ſpirit of gratitude and veneration, which has ſanctified the Evangeliſts, the Apoſtles, and the Saints amongſt the Chriſtians: but Poets, time, and human incongruity, what have they made in after-times of their glory, and of the arts and ſciences which they taught? Let any one judge, who knows ſomething of the hiſtory of mankind, whether the well-deſerved reputation of their names has ever ſhone in its pureſt luſtre, and whether their popular and ſalutary arts and ſciences have ever been practiſed in that public-

ſpirited benevolent manner, in which they had left or delivered them to mankind. Their names and their hiſtory have been involved in clouds of darkneſs and legends, and their arts and ſciences by their will, the inheritance of all, have been engroſſed by the ſelfiſh few. This happened in a very natural manner. Whether it happened neceſſarily, I will not determine; obſerving only, that making an excluſive trade of ſciences and of arts, has never anſwered, and never will anſwer, the great and univerſal intereſt of mankind.

The moſt uſeful arts are preciſely thoſe which ſtand in an immediate connexion with the moſt general, moſt natural, and moſt indiſpenſable wants of mankind. Their object is food, dreſs, and ſelf-preſervation. They muſt of courſe have been invented or practiſed by every family or ſociety of men; and being on this account coeval with the firſt origin of mankind, their invention falls into the remoteſt antiquity of the primitive world, when a few natural wants of a few individuals, or of a few ſcattered families, could be ſatisfied by common ingenuity, in making uſe of the moſt obvious gifts and effects of nature, ſuch as every climate afforded. In that primitive ſtate, we ſee the arts of the Pecherais in Terra del Fuego, and of many little wandering tribes of men in almoſt every part of the world; and even the arts of civilized nations would be lowered again,

and

and turned down nearly to the ſame ſtate, if by ſome ſudden revolution they ſhould happen to be at once deprived of the advantages of their climates, and expoſed to the hardſhips and wants of other climates. Commodore Byron left and preſerved on the coaſt of Chili, and the Ruſſian ſailors for many years left, and by their ingenuity and perſeverance preſerved, on the coaſt of Spitzbergen, will make good the aſſertion; and prove moreover, that wants and climate, going hand in hand, are the natural and firſt teachers of men, who for their vigour, ingenuity, and perfectibility, muſt be allowed to be lords of the world.

The ſelf-invented arts of different nations, (and and why ſhould not a ſimilarity of wants or cauſes have produced a ſimilarity of arts and remedies?) muſt for theſe reaſons have been very ſimple, rude, and local in the beginning; that is, they muſt, under different climates, have appeared under different modifications. The canoes of ſome Indians, made of hollowed trees, ſpeak a climate which produces plenty of timber; the canoes of the Greenlanders, made of ſeal-ſkins, and thoſe of the Eaſter-Iſlanders in the South-Sea, being poorly made up, and ſown together, of little bits of wood, ſpeak a diſmal want of wood. The form of the Chineſe buildings and columns, is plainly that of the original tent of ſavages, wandering in warm climates, which produced light and

ſlender bamboo-trees. The form of the Egyptian wonders of architecture ſeem plainly to tell, that the firſt inhabitants of that ſcorched climate, had cool rock-caverns to reſort to for ſhelter; and that, when their increaſing numbers attempted to imitate nature by art, they had little or no wood, but plenty of large rock maſſes. The old Indoos, being nearly under the ſame climate, ſeem to have built their moſt ancient Pagodas upon the ſame principles. The Greeks and Romans allow, that the Prototype of their moſt magnificent marble palaces was the original hut, made of timber, and even yet uſed in the milder climates of Aſia. The dreſs of the Turks, Perſians, Poles, and Hungarians, is of a different cut, but trimmed with fur, becauſe they are offſprings of different nations in the northern parts of Aſia, where dreſſing in fur is the advice and claim of the climate. The ſame original locality or nationality may be traced in the manipulations and technical words of the various arts of huſbandry, hunting, fiſhing, fighting, and curing diſeaſes; and as by ſo doing the origin of nations may be ſtill more aſcertained, and the invention of ſome arts purſued to their firſt beginning, it will likewiſe help us to feel, that many foreign arts have been to our coſt introduced amongſt us, in ſpite of the climate; and what here I am chiefly to inſiſt upon, that the arts in the beginning muſt have been very ſimple and very rude.

Wants

Wants in that infant ſtate of ſociety of hunters and fiſhermen, were preſently and beſt removed by the ſimpleſt application of thoſe natural effects or productions, which men experienced and ſaw before them. The cauſes of things, their inveſtigation, methodiſing their accidental inventions, and fixing them for aftertimes, were then abſolutely out of the queſtion; and ſo they were even when the encreaſing numbers and wants of theſe unſettled wanderers made the improvement of their original arts, or the introduction of new ones from abroad, the moſt acceptable gifts, which friends of mankind could beſtow upon them. The Greeks were indeed but a very raw and ignorant people, when their gods and heroes may be ſuppoſed to have inſtructed them. So were the Britons and Germans, when their conquerors, the Romans, and the firſt Chriſtian miſſionaries or apoſtles, acquainted them with the arts of making their life more comfortable. Each family held them as a treaſure, and handed them to their deſcendants in a mere traditional manner. It is no wonder, therefore, that old tradition and hiſtory ſpeak of Princeſſes ſkilful in the arts of the loom, of Sovereigns dreſſing their dinners, guiding the plow, and tending their herds. Her Highneſs Princeſs Nauſicaa went to the river waſhing and ſcowering her linen; nay, even Reverend Abbots and Holy Prieſts are celebrated in the firſt ages of Chriſtianity amongſt

the Northern European nations, for having been ſkilful and laborious plowmen, gardeners, vintners, huſbandmen, carpenters, joiners, painters, and phyſicians.

This traditional ſcience of the arts was a natural conſequence of the ſcattered, paſtoral, and rural life, and it was attended with circumſtances which proved no advantage to them. Being confined to ſingle families, and their wants alone, their practice would but accidentally improve them, and theſe improvements were liable to be forgotten. Moreover, their drudgery muſt of courſe be left to the ſlaves, who for many ages, even in the politer nations, were employed to carry on the manual arts. Deprived of liberty and property, they were the more inclined to drudge on in a dull, ſtubborn, habitual manner, without any mind for improvement.

That nevertheleſs, the manual and mechanical arts amongſt the Phenicians, Egyptians, Greeks, Carthaginians, and Romans, have been brought to a remarkable degree of perfection, was owing, not indeed to their ſlaves, but to the ſuperior good ſenſe and activity of their maſters; to circumſtances which produced a nearer connection of mankind in general; to wide extended navigation, commerce, and conqueſts; and finally, to a mercantile ſpirit and a culture of ſcience, which have ever been the reſults and diſtinguiſhing bleſſings of human ſociety, or govern-

government brought to the higheſt degree of perfection.

Some of theſe reaſons have at laſt reſcued the manual and mechanical arts in Europe from the hands of bungling ſlaves, and brought them into the hands of free people; but that happy revolution has in moſt parts of Europe ſerved the arts only by halves. It has been a great advantage to them; but having made more or leſs excluſive trades of them, they have been, and ſome of them are ſtill kept as jobs and ſecrets, by ſhort-ſighted and narrow-minded mercantile ſelfiſhneſs.

This plainly appears by the ill-digeſted ſtatutes and cuſtoms of many profeſſions and trades, which, if poſſible, would be independent patent companies, at the expence of the whole; the very names of the art and myſtery *of apothecaries, of clothworkers, of barbers, of cordwainers, and other trades, as expreſſed in the charters of their corporations at London, are ſtriking inſtances to what lengths that unpatriotick ſelfiſhneſs has been carried in former times; and even, if the word* myſtery *in theſe charters ſhould be conſidered only as an equivocal, othographical blunder, inſtead of* meſtier, *or* mêtier, *there are thouſands of proofs that this old ſpirit of ſelfiſhneſs is yet alive, ever willing to take advantage of the knowledge of others, and never willing to promote it. Let us add the abſurd contempt in which the proud*

proud Barons and the ſelf-conceited ſcholars have held formerly, and even yet hold, the greater part of the pretended ſervile and low mechanical arts, and we cannot wonder, that the progreſs and improvement has been ſo ſlow, and that many of them are ſtill in a ſtate of infancy.

It is only in the wiſeſt and moſt enlightened ages, that we find ſome philoſophers and wiſe men, ſtepping down from the giddy heights of their exalted ſtation of learning, into which the barbarous ignorance of the vulgar and their own conceit had placed them, in order to fix, to rectify, and to improve the arts. Such ages produced amongſt the Greeks and Romans, what Euclides, Hippocrates, Galen, Vitruvius, Columella, Cato, Pliny, Theophraſtus, and ſome others, have left us on the arts; and it is in the true ſpirit of thoſe glorious times, that after ſo many loſt ages of ſcholaſtical dullneſs and mercantile ſelfiſhneſs, the Royal Academy at Paris, Mr. Chambers, Dr. Lewis, the Authors of the French Encyclopedy, and many friends of mankind in ſeveral parts of Europe, have undertaken of late to fix the various arts of mankind for after-times, and to eſtabliſh them upon the principles of nature and mathematicks, better known at preſent than they ever were before. But various is their preſent ſtate in different parts of Europe.

The Art of War *is in theſe laſt two hundred years reduced in France, and eſpecially in Germany,*

upon

upon ſo evident and ſcientifical theories, aſcertained by practice, that theſe powerful empires muſt be the moſt happy of all, if tremendous armies, now and then methodically butchered, and the ambition of Sovereigns, flattered by conqueſt, did enſure them the bleſſings of peace, or any other bleſſing at all. There has been in thoſe countries too much occaſion for the improvement of this neceſſary and terrible art.

The Nautical Art *in all its branches, on the contrary, is brought in England to the higheſt degree of perfection, becauſe it is the kingdom of the ſeas; ſo are huſbandry and numbers of mechanical arts and manufactories, becauſe it enjoys the advantages of a plentiful ſoil, and of freedom in a higher degree than any other.* Sed

Tu regere Imperio populos Britanne memento,
(Hae Tibi ERUNT artes) pacique imponere morem,
Parcere ſubjectis & debellare ſuperbos.

But the Art of Mining, *and its many ſubordinate branches, are in Germany, and its dependent countries, for various reaſons, ſo highly improved, that for theſe laſt ages Germany has been juſtly conſidered as the moſt ancient and beſt ſchool for miners. Though Tacitus, in his romantic account of Germany, told the Romans, that the Gods, either by a providential care, or by their diſlike of the nation, ſeemed to have left the Germans unprovided with mines and metals,*

or

or rather to have kept them till then unacquainted with their uſe and ſcience; things have, however, ſince wondrouſly changed, both in reſpect to the mines, and in reſpect of their ſcience. The greateſt and richeſt chains and tracts of metallic mountains, *which juſtly may be ranked with thoſe in Peru and in Hungary, have been diſcovered there in a very remote antiquity, when the other kingdoms of Europe had ſcarce any idea of that kind of inland riches; and there have been ever ſince, and there are more mines and mountains yet actually working in Germany alone, than perhaps in all the other parts of Europe put together. Some mines on the Rhine and Danube, in Lorrain, Alſace, Briſgow, Suevia, and the ancient Noricum, ſeem to have been worked already in the decline of the ancient Roman empire. Many in the interior parts are reported to have been opened under the race of Charlemain. The mines in the Rammelſberg near Goſlar, and ſome of the adjacent ones in the Harz-mountains, belonging to the Electorate of Hanover and the Duchy of Brunſwick, are fairly proved to have been diſcovered and worked to advantage as early as the middle of the tenth century (between A. C. 950. and 1000.) And the diſcovery of thoſe in Haſſia, Miſnia, Sileſia, Moravia, Franconia, Tyrol, Steyermark, Carinthia, and Carniola, cannot be ſuppoſed to have been much poſterior in time to that of the former.*

To

To judge by the technical language *of the German miners, waſhers, aſſayers, and melters, they do not ſeem to have learnt, or had their different arts from the Romans, or other foreign nations. It is downright German. It proves at leaſt what I have ſhortly hinted before, that theſe arts are of very old ſtanding in Germany; and as it is very compleat in every reſpect, and almoſt the ſame in the moſt diſtant provinces of Germany, it proves, that for a long ſeries of ages theſe various arts have never been diſcontinued, and on that account they may be conſidered as national. Being by their very object and remarkable ſucceſs naturally recommended to deſpotic Sovereigns, they have been very early favoured and taken notice of by the many legiſlators of Germany; and it muſt be owned, that the metallic general and particular laws of Germany, having been ſoon refined, have greatly contributed to keep theſe mining arts alive, by keeping the above mining countries in uninterrupted ſucceſsful employment. And happy has it proved for Germany, as the inland parts of that extenſive and populous country, without the working of theſe numerous mines, muſt have loſt thouſands of unemployed hands, and ſtand worſe in the balance of trade than it hitherto is found to do. The mathematicks, mechanicks, hydraulicks, and the principles of chemiſtry, have been pretty early applied in Germany, to the traditional and empirical art of mining, as*

every

every one may judge by the valuable writings of Georg. Agricola, *(born* 1494——1555*) that excellent author of immenſe and practical erudition, who for theſe laſt* 250 *years has ſtood unparalleled and foremoſt amongſt the claſſical authors on mining; and as during theſe laſt* 300 *years, Germany has produced a* Copernicus, Purbach, Kepler, Sturmius, Leibnitz, Wolf, Kaeſtner, Meyer, Segner, Euler, Lambert; Albertus Magnus, *(born* 1193—1280*)* Paracelſus Theophraſtus, *(born* 1493—1541*)* Sennert, Beccher, Kunckel, Stahl, Glauber, Hofmann, Juncker, Vogel, Marggraf, Model, Newmann, Cartheuſer, Ercker, Cramer, Schlütter, Gellert, Lehmann, Poerner, Pott, Gerhard, Juſti, Waiz, Spielmann, *and* Meyer,——*beſides many other* unmonumented *but great names in the hiſtory of mathematicks and of chemiſtry; it is not without ſome juſtice that foreign nations have conſidered the Germans as their maſters in the art of mining, and not without ſome good reaſon, that the Germans have firſt endeavoured in their writings and academies to give this art that ſcientifical form which it is capable of, and to keep pace in it with the Engliſh, Swedes, Italians, and French, who of late have begun ſucceſsfully to emulate their example.*

The object of this art is,

1. *The working and building of the mines in which they are found;*

2. *Their*

2. *Their extraction and ſeparation from the ores and ſubſtances in which they are involved and mineralized*; *and*

3. *The inveſtigation of foſſil and metallic ſubſtances or ores.*

Accordingly it is eſtabliſhed upon different ſciences, and may be divided into different parts.

I. The Art of working and building the Mines *conſiſts of a ſkilful application of natural philoſophy and the mathematicks to this particular object*; *it is therefore to be divided into the following ſubordinate parts:*

a. *The art of ſurveying and drawing mines.*

b. *The art of breaking and blaſting the rocks and veins.*

c. *The art of timbering and building the works under ground.*

d. *The art of correcting the air, which under ground, for many reaſons, is liable to be damp, and unfit for reſpiration.*

e. *The art of hydraulicks. And,*

f. *At laſt, the art of mechanicks, for draining the mines of the ſubterraneous water, and for clearing them from the rubbiſh or ore by the various forces of nature, or various engines.*

The old Egyptians, Greeks, and Romans, muſt be allowed to have not been deficient in theſe mathematical parts of the art of mining. Many of their ſubter-

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raneous buildings yet extant, and many of their great works of architecture, which ever will be objects of intelligent admiration, prove it beyond exception, and give credit to the ingenuity of their engines, which certainly we know but very imperfectly by their own written accounts. It would be extremely unfair to ſuppoſe that they had no engines; and that, unconcerned about the wretchedneſs of ſentenced ſlaves, whom they employed in the mines as many Europeans employ the unſentenced innocent blacks, they left them unaſſiſted by their ingenuity to every danger and hardſhip, which of courſe muſt befall the workmen, if they are led in the dark without intelligent guides, and condemned to do the various hard buſineſs of the mines by the ſtrength of their hands, which we ſcarce are able to perform with the animated powers of nature enſlaved by art. For unprejudiced mathematicians, or for intelligent antiquarians, it would be no hard taſk even yet to determine what degree of perfection they had actually attained in the above mathematical arts of mining. The Cloaca Maxima at Rome; the Emiſſario of the Lago Albano at Caſtel Gandolfo; their various aqueducts and ciſterns; their coloſſal granite Obeliſks cut in Upper Egypt, and thence tranſported as far as Rome; ſome mines in Tranſylvania ſuppoſed to be Roman works, and the watering engines, ever ſince the moſt diſtant antiquity, uſed in Egypt, would by

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an analytical examination, do juſtice to their ingenuity and unconquered ſpirit. But however aſtoniſhing they may appear to us in their works, and in the accounts and writings of Archimedes and Euclid, who would ſeriouſly pretend that the modern invention of the magnetical needle has not made the art of ſurveying under ground actually more certain and more eaſy than it was before? Who can deny, that the modern invention of gunpowder, and the art of blaſting, has made us their maſters? Theſe powers of nature, which reſpectively lead us under ground, and arm us with the earthſhaking ſtrength of Pluto and Neptune, were abſolutely unknown to them. So were perhaps our various drawing and pump-mills, and our ventilators; ſo was the fire-engine, which is one of the moſt glorious monuments of Engliſh ingenuity, as, independent of the known powers of nature, it goes by a very active principle, in all the former ages ſcarce ſo much as noticed.

II. *The art of* extracting *and* ſeparating the Metals, *from the various heterogeneous ſubſtances, in which they are contained and mineralized, is carried on by water and fire, or by waſhers and ſmelters. It is therefore to be divided into the following ſubordinate arts:*

a. *The art of pounding the ores in mills.*

b. *The art of waſhing them.*

c. *The art of* metallurgy, *which, by the agents of fire and acids, ſeparates, purifies, and reſpectively produces and deſtroys thoſe various metallic and mineral ſubſtances, which are contained in the ores and foſſil bodies, and are ſubſervient and neceſſary to ſo many wants of human ſociety.*

d. *The* Art of aſſaying *or* docimaſy, *is rather a part of metallurgy, teaching, by ſmall and nice aſſays of acids, fire, and weight, to determine the value, mixture, contents, and nature of the raw ores, or of the metals and mineral ſubſtances, produced by the greater operations of metallurgical furnaces and manufactories.*

If the Ancients, eſpecially the Egyptians, Greeks, and Romans, muſt be allowed to have been pretty good empyrical metallurgiſts and ſmelters, as plainly appears by many of their works and accounts, it muſt, however, be allowed on the other ſide, that they have not left us any other, but perhaps a few traditional practices and proceſſes, which, in reſpect to metallurgy and chemiſtry, are more vague and leſs to be depended upon, than in other more determined and evident arts and ſciences. We can make but very little of their Hermes *and* Theophraſtus, *and they had no Archimedes or Euclid for chemiſtry; nor did they make uſe of it either in the preparation of their medicines, or in the examination of the elementary ſubſtances of nature. Their medicines were mixtures or decoctions*

decoctions of groſs ſimples and ſubſtances, ſuch as the vegetable, animal, and mineral kingdoms offered them; and their natural philoſophy was, in reſpect to the elementary parts, but an ingenious gueſſing and reaſoning in the dark, as it ever has been, and muſt be, without the aſſiſtance of chemiſtry, which reſolves nature into its elements, and by acquainting us with many of their properties, unobſervable and unobſerved in their former combination, teaches how to make uſe of them, either in their concentrated ſimplified ſtate, or in their new modelled combinations. It is to the Arabians that we are indebted for the advantages which philoſophers, phyſicians, œconomiſts, and tradeſmen, have reaped, and may reap, from this ſcience, or rather from that ſcientifical chemiſtry, which we are at preſent poſſeſſed of, and have ſo much improved. Many of its technical names and its uſual characters would prove it, if the writings of Geber, Rhazes, *and many others, had left us any doubt. We muſt not, however, deprive our anceſtors in Germany or England of their claim to the invention or uſe of more ancient metallurgical proceſſes. I have mentioned already, that the diſcovery and working of the mines at Goſlar falls between the years* 950 *and* 1000, *after the age of* Geber *and* Rhazes, *who lived in the ſeventh and tenth century, but before the introduction of Arabian learning in Europe, which coincides with the cruiſades,*

and, to our knowledge, has produced no European chemiſts but in the beginning of the thirteenth century, when Albertus Magnus, *or* Albert von Bolliſtaedt, *(born* 1193—1280*) and* Roger Bacon *(born* 1214—1294*) appeared. The metallurgical operations at Goſslar ſeem, therefore, in thoſe earlier times, to have been eſtabliſhed upon traditional proceſſes, which were either Roman or German; and as, on account of the mixed irony and zincous refractory ores, theſe operations, though ever ſo much improved at preſent, are extremely various, compound, hard, and tedious, there is good reaſon to ſuppoſe, that even the traditional and empyrical ſcience of the ancient German metallurgiſts was by no means inconſiderable. We have ſcarce any credible account that this traditional art ſhould have been properly fixed for poſterity, eſtabliſhed upon ſcientifical principles, and remarkably improved by chemiſtry, earlier than the times of* George Agricola, *(1555) who for his valuable books* De Natura Foſſilium *and* De Re Metallica, *deſerves to be called the father of thoſe many excellent chemical metallurgiſts whom Germany and other countries have produced ever ſince. I will not enlarge upon the dates and reſpective merits of* Agricola, Encelius, Erker, Becker, Stahl, Schlütter, Cramer, Gellert, Lehman, Vogel, Juſti, Henckel, Pott, Marggraf, *and others; nor upon their many excellent diſciples in Sweden, France,*

France, and England, such as Bacon, Rob. Boyle, Barba, Hellot, Macquer, Blake, Lewis, Woulfe, Beaumé, Sage, *and others; but I beg leave to obſerve, that metallurgy, being, upon the whole, and for the practical uſes of the ſmelters, reduced upon pretty evident principles, is however very far from having attained its higheſt degree of perfection in reſpect to philoſophical chemiſtry. Many mineral ſubſtances, ores, and foſſils, are ſtill very problematical; but the general ſpirit of enquiry ſpread over Europe bids fair to improve it in a quite different ratio from that in which it proceeded formerly. Mr.* Cramer's *new metallurgy, and Mr.* Delius's *propoſals for copper-refining in Hungary, inſerted in this publication, prove, that many metallurgical operations are capable of improvement by the principles of chemiſtry, duly applied; and the very principles of chemiſtry are at the eve of being better aſcertained, and of being conſidered in a new light. At leaſt very promiſing proſpects have opened within theſe few years from Dr.* Prieſtley's *late experiments on air, and from the ingenuity and ſagacity of Meſſ.* Pott *and* Marggraf *at Berlin, and of Mr.* Beaumé *and Mr.* Sage *at Paris. The former have ſeemingly acquainted us with new qualities and new ſorts of air; but, properly ſpeaking, they have exhibited to us only the phænomena of a new, active, ſubtile, elaſtic, and powerful ſolvent or menſtruum hitherto not at all, or but imperfectly, made*

uſe of in our chemical analyſes and aſſays. However, they muſt of courſe continue to enrich chemiſtry, and its dependent arts, ſciences, and trades, with many valuable diſcoveries. I am confident the ſame muſt be the caſe with Mr. Sage's *late and very ingenious theory and experiments on mineralization, which being above the underſtanding, or againſt the traditional creed of many chemical Virtuoſi, have opened in France a new and ample field of abuſe, and every where elſe an ample field of ſpeculation, and of diſcoveries. It is with the new principles and diſcoveries in natural philoſophy exactly as with the noſtrums in phyſic. At firſt they are good* for every thing; *ſoon after old Method cries them down as good* for nothing; *but experience proves them at laſt to be good* for ſomething.

III. *The* Art of inveſtigating, diſcovering, and purſuing the metallic and mineral ſubſtances under ground, *is upon ſuch terms as allow ſome hopes of eſtabliſhing it upon certain principles.*

Baron Pabſt v. Ohain's *idea of a ſubterranean geography, ſeems to imply that he thought of it; and the mineralogical accounts of Meſſ.* Ferber, *Baron* Born, *and others, prove to me, that ſuch an art* may be *invented, and likewiſe that its invention is in ſome forwardneſs,*

I ſhall not ſpeak of Chance, *that great diſcoverer of mines, formerly worked and yet working; nor ſhall*

ſhall I enlarge upon the virgula divinatoria, *or* divining rod, *tried by philoſophers in England, even ſo late as the times of* Robert Boyle, *and not an hundred years ago ſeriouſly applied in France for the diſcovering of mines, treaſures, wells, robbers, and murtherers. We do not know how to methodize the former, and we are fully convinced that the latter has never anſwered any purpoſe but that of making dupes. They are, therefore, beſt left and recommended to ignorant people, who delight in* darkneſs viſible.

The only principles, upon which this very intereſting art may and muſt be eſtabliſhed, are Mineralogy *and* Oryctology.

Mineralogy, *or a ſufficient hiſtorical knowledge of the foſſil bodies, is of abſolute neceſſity to the miner and to the learned. It acquaints the former with the name, form, colour, texture, appearance, value, and other properties of the foſſils, and it makes ſcience intelligible by ſcientifical, determined names of their characteriſtic properties. For want of this ſcience, quantities of rich ores and foſſil ſubſtances have been formerly thrown amongſt the rubbiſh of the bingſteads; and there is ſcarce a mining country in which they have not ſome time or other paved their highways with ſtones and rocks of value. I know, from very reſpectable authority, that that was formerly the caſe of the Cobalt-ores in Heſſe, which at*

preſent produce an annual revenue of about 14,000*l. clear of expences. That the deficiency of languages in that part of the art of mining, which treats of foſſils, has been hitherto a great obſtruction to its improvement, will not be denied, and has been ſeverely felt by every one who wiſhes to inſtruct, or to be inſtructed, in mining, metallurgy, chemiſtry, and natural hiſtory. Only a very few foſſil ſubſtances have determined names in common life, and in the languages of the politeſt nations. Such are the purer and finer metals, ſome ſalts, and ſome ſtones. The infinite variety of their mixtures, different ſtate, mineralization, chemical properties and affinities of their colour, form, hardneſs, weight, ſituation, native place and origin, if underſtood or noticed by the miners and metallurgiſts, are expreſſed either by technical or by provincial names, which, to the generality of men, or to foreigners, are what formerly the Greek was to the Monks. I beg leave to obſerve, that they have not been hitherto taken ſufficient notice of in thoſe numerous mineralogical ſyſtems, which have appeared theſe laſt fifty years. Their authors conſider mineralogy under too confined points of view; and many of them have indulged themſelves in new and very often arbitrary names and idle claſſifications; ſo that an egregious and nearly Babylonian confuſion has been added to the old deficiency of languages; and that ſcience, upon the whole, has been leſs benefitted by them*

them than juſtly might have been expected. It muſt be acknowledged, however, that the chemical claſſification, and the nomenclature of foſſils, introduced into mineralogy ever ſince the firſt appearance of Pott's Lithogeneſy, *and the ſyſtems of* Wallerius *and* Cronſtedt, *have been great advantages to ſcience. Being eſtabliſhed upon their conſtituent parts, and upon reality, they may, under certain allowances, prevent further obſcurity and confuſion, and perfectly anſwer the views of chemiſts and metallurgiſts. But as they ſtand at preſent, can they fully anſwer the expectation of miners, of natural philoſophers, and of friends to ſcience? They muſt be the baſis of mineralogy; no competent judge, and no man of ſenſe, will diſpute it; but to benefit the miner, they ſhould be explained in his own technical or provincial language, which is generally neglected; and to ſatisfy the natural philoſopher, they ſhould be eſtabliſhed only upon evident principles of chemiſtry, and never preſume to claſſify foſſil ſubſtances, which are not hitherto ſufficiently examined. Moreover, many foſſils are ſo compound in their mixtures, that a chemiſt may make any thing of them; and moſt part of their chemical characters are ſo far abſtruſe and obſcure, as they relate rather to a future ſtate than to that raw and natural one, in which we ſee and diſcover them. A chemical mineralogiſt will at moſt tell you what foſſils are good for, or what you may make of them,*

them, or of what they are compoſed. He will thence make you gueſs likewiſe by what natural operations they may have received that raw and natural form in which we find them. But fire, crucibles, retorts, alembics, acids, and touchſtones, are inſufficient to teach with certainty by what natural operations they really were produced. Theſe are facts, which chemical principles and good reaſoning will and muſt explain; their reality muſt be aſcertained by hiſtorical evidence, or by ocular inſpection and experiment, for the ſame mixture of foſſils can be produced by fire and by water, by melting and by ſolution, by ſublimation, by precipitation, and by other operations. This we plainly experience in our laboratories; and as theſe operations are really different from each other, and generally productive of particular forms and circumſtances; it is but juſt to ſuppoſe, that the ſame or ſimilar, operations in the great laboratories of Nature, are and muſt be productive of ſimilar forms and circumſtances, and that the particular forms and circumſtances in which the foſſils are found, ſhould be nicely noticed by mineralogiſts, who pretend to give full information and adequate ideas. They muſt henceforth examine, rank, and deſcribe them not only as individual ſubſtances by their chemical properties, colour, texture, and form, but they muſt conſider them likewiſe under the more extenſive point of view of their former natural ſituation, ſtratification,

tion, connection, and vicinity with other foſſils in the native places, beds, and veins in which they are found. By ſo doing, mineralogy receives a latitude, of which it hitherto has been deprived; foſſils appear in their only and true natural order, which is that of their chemical properties and of their natural ſituation; the foſſil beds and veins become monuments of former revolutions, or of natural chemical operations; and, in ſhort, the art of diſcovering or purſuing them under ground will be reduced into probable rules. I do not indulge a chimerical fondneſs for a favourite idea. I have traced the outline of a mineralogical ſyſtem upon theſe principles; that is to ſay, a ſyſtem which goes hand in hand with the principles of chemiſtry and of ſtratification; and I muſt be falſe to truth, if, for an ill-placed baſhfulneſs and modeſty, I ſhould not publicly acknowledge and recommend its advantages. Hints of this new mineralogy are thrown out in my account of the German volcanoes, and eſpecially in my preface and index to Ferber's Letters on Italy, and to this publication. I hope they will ſuffice for the intelligent, and make good the aſſertion, "that the invention of the art of diſcovering mines is in good forwardneſs."

Philoſophers, ancient and modern, have hitherto conſidered mountains in general from a point of view which was too confined, or entirely different from that

that of mineralogy and mining. For being unimproved by the light of volcanoes, and by that extenſive knowledge which they might have reaped in the deepeſt mines of the higheſt mountains, and from the inſtruction of unſcientific miners, they ſtuck only to their libraries, aud to the uppermoſt cruſt of the earth, which, without any great trouble to themſelves, they had an opportunity of examining in the moſt pleaſing countries, and in the moſt ſuperficial quarries of ſand-ſtone, limeſtone, and ſlate. We are not to wonder, therefore, that orology, or the ſcience of mountains, is ſo little underſtood amongſt the learned; and that the deſcriptions of the higher mountains in Peru, Teneriffa, Switzerland, and different parts of Europe are generally filled with meteorological obſervations, botany, and other accounts, which leave their very nature in a minerological and orological reſpect full as unknown as they were before. The conſequence was plain, that general concluſions have been too raſhly drawn from a ſingle kind of mountains, and that the pretended ſyſtems of the origin of the mountains in general are, for the greater part, ſo very romantic and ſuperficial.

Experience and hiſtory prove the mountains and ſtrata of the earth to be of a very different nature, origin, and antiquity. They have been accordingly divided by Mr. Giovanni Arduino, *at Venice, into primitive, ſecundary, modern, (Tertiarii) and volcanic mountains. I ſhall not repeat from Mr. Ferber's Letters what*

what characters he has given of these various mountains; but I must notice, that primitive mountains, *or strata, have been spoken of very early by other philosophers, and that they are generally understood to consist of simple rocks, less stratified than the incumbent strata, and never containing in their paste and mixture any petrefactions, of adventitious, organic bodies of shells, other animals or plants. That there are such mountains and strata, is unquestionable, because they are found either at the bottom of the deepest mines, or bare appearing through a variety of incumbent other strata at the summits of the higher mountains. But it would be extremely presumptuous to insist upon their being true primitive mountains. The only consequence which fairly can be drawn from Mr.* Ferber's *and Mr.* Arduini's *Observations in his Raccolta di Memorie Chimico-mineralogiche: Venezia* 1775*) is, that the reddish granite (granito rosso d'Egitto) and the micaceous and horn-slate, for being every where found below a variety of other incumbent strata, must, in respect to time and origin, be anterior and different from them, and that, for this reason, they may justly be called the most antient rocks hitherto known.*

The secundary strata and mountains, *chiefly consisting of limestone and argillaceous slate, are accumulated on the former, and the* more modern ones *are incumbent on these. They owe their origin to a*

variety

variety of cauſes and accidents, as may be proved even by hiſtory. Nor are even the volcanic mountains and ſtrata *produced by and under the ſame circumſtances, as ſufficiently is hinted by me in the preface to Ferber's Letters, and in my account of the German volcanoes. Of courſe they muſt all of them, for chemical and hiſtorical reaſons, offer a variety of circumſtances in the form, mixture, and ſubſtance of their paſte and rocks, in the ſituation of their ſtrata, in the nature and direction of their veins, and in the nature and mixture of the paraſitical rocks, which are produced in their veins and caverns.*

The miners in Germany, whoſe ideas have been generally confined to their main object, and to the nature of the mountains, in which they worked, have, inſtead of the above diviſion of the mountains, divided them into flat *and into* gang *mountains.* (Flots, and gang-geburge.)

By the former they underſtand ſtratified modern mountains, which generally ſurround the higher and more ancient ones, and are worked not for their veins, but for the contents of their ſtrata, which are leſs dipping, and more horizontal, than thoſe in the higher mountains. Such are the ſlate copper-works in Mansfield, the coal mines in general, and many iron mines.

By gang-mountains, *they underſtand higher metalic mountains, which are working for their* veins *or* ſtocks, *and conſiſt in Germany, Bohemia, and Hungary,*

gary, of granite or micaceous and horn ſlate, or of what naturaliſts would call primitive mountains. By gang, or gang-geburge, *they underſtand likewiſe thoſe various ſubſtances which either do never appear in ſtratified rocks, but in veins (or gaengen) only, viz. the whole tribe of paraſitical ſtones, of quartz, ſpar, fluor, &c. or thoſe, which in particular caſes are found to fill veins, joints, and ſtocks, as granite, ſlate, zinnopel, grit, clay, and other matrices of metals and minerals. In this ſenſe, it is uſed to diſtinguiſh them from the rocks of the mountain on both ſides of the vein or ſtock; and it is abſolutely a relative denomination, ſince the ſame ſubſtance may be in ſome places particular to the vein, and in ſome others to the mountain.*

Father George Agricola *is undoubtedly the firſt, and, I dare ſay, till of very late, unparallcled in reſpect to ſome ſcientifical knowledge of the veins, their run, and their rules. What he knew and drew of it, he knew from the miners; but as ever ſince they have ſcarce been conſulted at all, by philoſophers who attempted to create and to dream mountains and worlds, and ſyſtems of mountains and worlds, it is no wonder that hitherto the learned ſhould have ſo little added to that ſtock of ſcience, which he has left us. The beſt general accounts, beſides his, are* Lehman's *two German Treatiſes* on the Flat Mountains *and* the Metallic Matrices, *and ſome general principles in thoſe valuable* elements of the art of mining,

which

which have been publiſhed by the academy for miners ſince 1765, *eſtabliſhed at Freiberg in Saxony. But we are very far from being thoroughly acquainted with their nature. We know them only by a few good obſervations made in Germany, Sweden, and Hungary. By theſe it appears*

I. *That the veins of the ſame mountain, nay, of very extenſive tracts of land, are ſubject to the ſame rules in reſpect to their direction, dipping and croſs-joints, and of the ſame nature in reſpect to their contents, ores and foſſils.*

II. *That veins of the ſame mountain, running in the ſame direction, and through and under the ſame rocks, are loaded with the ſame ores and foſſils; and accordingly ſeem to have been produced and loaded by the ſame natural revolution.*

III. *That thoſe which croſs them in contrary directions, ſeem very often to have been produced in different times, and by different revolutions, when they are loaded with different ſubſtances.*

IV. *That the veins of the incumbent mountains, for example, of calcareous or ſlate mountains, have their particular rule of direction, dipping, croſs-joints, and contents, very often unaffected by the different rule of thoſe veins, which are in the lower rocks of ſlate or granite; whence it appears, that theſe latter were, in point of time, anterior to the former.*

V. *That*

V. *That the veins commonly turn quicker and richeſt in the croſſings.*

VI. *That ores and metals are produced in the croſſings, which did not appear before either in the main vein, or in the croſs-joints.*

VII. *That they are generally quick when running or dipping along, and between the limits of different adjacent or incumbent rocks; for example, in the limits of granite and incumbent ſlate, or in thoſe of ſlate and incumbent limeſtone.*

VIII. *That their contents or loads of rocks, paraſitical ſtones, ores, and metals, generally have a natural and chemical relation to the rocks in and under which they are running; that is to ſay, that veins in granite carry tin, wolfram, pyrites, black-lead, quartz, and granite grit; that veins in limeſtone carry ſpar and fluor, beſides lead and other metals; that veins in the Hungarian metallic rock are filled with quartz, fieldſpath, gold and ſilver; that veins in hornſtone produce gold, ſilver, and zinnopel; that veins in ſlate are loaded with argillaceous ſubſtances, quartz, ſilver, lead, copper, and iron; and that the natural productions of limeſtone, ſlate, porphyry, trapp, and volcanic beds, if incumbent on deeper veins, appear in them, or produce modifications of foſſils, which their own matrix, rocks, or ſides, would*

not have produced by themſelves. To verify theſe aſſertions, I refer the intelligent reader to a tabellary abſtract of ſome mines deſcribed in this publication, and beg leave to obſerve, that, by ſimilar abſtracts of all the good mineralogical and orological accounts which are come to my hands, I am enabled to give in a new edition of my Syſtem of the Earth, ſomething more ſatisfactory about orology and the metallic mines in general than hitherto has been given to the public. They are the work of many years, and of great labour; and with the various improvements of the above Syſtem, not undeſerving that generous ſupport and encouragement which, though a foreigner, I make bold to expect from unprejudiced friends of ſcience, and from thoſe gentlemen, whoſe intereſt and buſineſs it is to ſee ſomewhat clear under their own ground, and to prevent thoſe many impoſitions and diſappointments, to which adventurous, unprincipled miners are ſubject.

I. *This Syſtem of the Earth and Mountains is to appear in two volumes in* 4to. *and to contain*

II. *An exact deſcription of the ſurface of the earth and its ſtrata; with an appendix of my own, and various of the beſt orological obſervations reduced into tabellary forms.*

III. *Hiſ-*

III. *Authenticated accounts of the various revolutions which have produced, changed, and affected the mountains, ſtrata, and veins.*

IV. *Candid and literary accounts of the beſt orological ſyſtems, eſpecially of that of the Greeks, and of the late Robert Hooke, who did not live to give it its due extent.*

V. *A ſhort explication of the phænomena on the ſurface of the earth, by the above hiſtorical accounts, ſupported by the principles of chemiſtry.*

VI. *An ample ſketch of a new ſyſtem of mineralogy for miners, laid down upon the principles of metallurgy and ſtratification, with a conſtant reference to the technical and provincial language of the miners and ſmelters.*

VII. *Some ſcientifical ſections, plans, and maps, beſide ſome inſtructive and ornamental drawings of unnoticed foſſils and petrifactions, will be added; and as I muſt be at the expence of ſome enquiries in the mining countries of Great Britain and Ireland before I can put the laſt hand to the work, which will not be without ſome expence, I deſire the friends of ſcience to take this work under their protection, to leave their names and orders at Mr. George Kearſley's, bookſeller, in Fleet-ſtreet; who likewiſe will take care of their commands and enquiries, directed to me, in*

whatever I may be uſeful to them. More particular propoſals will be publiſhed as ſoon as the ſubſcribed or ordered copies amount to a certain number. Meanwhile

Current utiliter mei
Nullo cum ſtrepitu dies;

and I ſhall continue the publication of other valuable mineralogical and orological tracts, which, for the better convenience of the purchaſers, will appear in the ſame form as this, and as Ferber's Letters. In the next I intend to lay before the Engliſh public

1. *Supplements to the Mineralogical Letters of* Baron Born, *taken from an improved edition, which lately has appeared in Germany.*

2. *Abſtracts from* Gio. Arduino's *Raccolta di Memorie Chimico-mineralogiche, Metallurgiche e Orittograficbe, publiſhed in* 1775 *at Venice.*

3. Ferber's *Accounts of the Mines in Derbyſhire, publiſhed in* 1776 *in Germany.*

4. Ferber's *Accounts of the Mines in the Palatinate.*

5. *Ab-*

5. *Abſtracts from Mr.* Colini's *Mineralogical Travels in the Palatinate*; *reſerving for other future publications the beſt mineralogical accounts of the mines in the Harzforeſt, Saxonia, Heſſe, Tyrol, Sweden, and Italy.*

R. E. RASPE.

London, Sept. 1776.

P. S. *The ounce ſpoken of in this publication is equal to one half ounce Engliſh, and the annexed orological tables are given only as eſſay, not as compleat abſtracts of the accounts contained in this volume. Moreover I beg to obſerve, that the ſmallneſs of the ſize would not allow to ſpecify the different ſpecies of ore, nor to give ſome other minute details.* Sed ſapienti ſat!

APPENDIX

TO THE

PREFACE,

OROLOGICAL TABLES

OF SOME

MINES

DESCRIBED IN

FERBER'S LETTERS

FROM

ITALY,

AND IN THIS

PUBLICATION.

Thoſe of the MINES at JOACHIMSTHAL, in Bohemia, to be compared with the MAP.

Name of the Place and Mine.	*Mountain, or Sides of the Vein.*	*Rock.*	VEIN. *Ore.*	*Direction.*	*Dipping.*
Faiſtriz, near Pegaw, in Steyermark. Ferber's Ital.	Limeſtone blue argillaceous ſlate.	Spar and quartz.	Leadglance, with ſilver.		
Idria, in Crain. Ferb. Ital. Lett.	Limeſtone blue arg. ſlate.	Slate.	Cinnabar and quickſilver.		
Feltrino. Ferb.	Limeſtone ſlate.		Quickſilver.		
Schio, in Monte Triſa. Ferb.	Limeſtone alternating with volcanic ſtrata.	Spar.	Silver, lead, copper, manganeſe.		
Valle di Gorno, in Bergamaſco. Ferb.	Limeſtone and lava.		Lead and blende.		
Montieri. Ferb.	Limeſtone and ſlate.	Spar and quartz.	Silver, lead, copper, iron.		

CROSS VEINS, *or* CROSS JOINTS.

Improving.				Cutting of, or striking dead.			
Rock.	*Ore.*	*Direction*	*Dipping.*	*Rock.*	*Ore.*	*Direction.*	*Dipping.*

Name of the Place and Mine.	*Mountain, or Sides of the Vein.*	*Rock.*	VEIN. *Ore.*	*Direction.*	*Dipping.*
Nagyag. Born.	Red clay, ſandſtone, metallic rock.	Feldſpath and fat quartz.	Gold and ſilver mineralized; auriferous antimony; arſenic; cinnabar.	South to North. All the quick veins parallel.	Weſt to Eaſt.
Toplitza. Born.	Clay ſlate, metallic rock.	Quartz.	Gold, red ſilver ore, lead.	South to North.	
Fuexes. Born.	Clay ſlate, metallic rock.	Quartz.	Gold.	South to North.	
Felſo Banya. Born.					
Borkul mine.	Hornſtone.	Zinnopel.	Gold and ſilver.		
Great Mine.	Hornſtone and metallic rock.	Zinnopel.	Gold and ſilver.		
Smolnitz. Born.	Micaceous and blue ſlate.	Clay and quartz.	Copper pyrites, and ſilver.	Eaſt to Weſt in hour 6. Three quick veins parallel.	In 75 degrees.

CROSS VEINS, *or* CROSS JOINTS.

Improving.				Cutting of, or striking deaf.			
Rock.	*Ore.*	*Direction*	*Dipping.*	*Rock.*	*Ore.*	*Direction.*	*Dipping.*
Quartz & fluor.	Sulphur, antimony, manganese.	In the hanging.				In the hading, croſſing the main vein in an acute angle.	
		East to West.	In 75°.			West to South in hour 9, or hour 21.	West to East, or to North.
		Bring the veins in the hading, and quicken them.				Bring the veins in the hanging, and ſtrike them deaf.	

Name of the Place and Mine.	*Mountain, or Sides of the Vein.*	*Rock.*	VEIN. *Ore.*	*Direction.*	*Dipping.*
Skemniz. Born.					
Spitaler Vein.	Clay ſlate, metallic rock.	Quartz and zinnopel.	Gold, ſilver, lead.	North to South, or South to North, between hour 12 and 4.	Weſt to Eaſt, between 30′ and 70′.
S. John's.	Metallic rock.	White clay and quartz in the hanging; zinnopel in the hading	Silver.	In the hanging of the former; and parallel.	
Beaverſtoln.	Metallic rock.	Quartz, zinnopel, ſpar	Gold, ſilver, lead.	North to South as above, between 12 and 4.	Weſt to Eaſt, between 30′ and 70′.
Thereſia.	Metallic rock.	Zinnopel.	Gold, ſilver, lead.	North to South.	Eaſt to Weſt; then vertical; at laſt Weſt to Eaſt.
Catharina-berg, in Bohemia. Ferber.	Gneiſſ.	Gneiſſ or grit of granite.	Silver, copper; mineralized and native.	South to North, or North to South, in hour 2.	Between 60′ and 90′.
Preſſniz. Ferb. Maria Kirchbaw.	Gneiſſ.	Gypſeous ſpar.	Silver.	North to South, in hour 12 and 1.	

CROSS VEINS, *or* CROSS JOINTS.

Improving				Cutting of, or striking dead.			
Rock.	*Ore.*	*Direction*	*Dipping*	*Rock.*	*Ore.*	*Direction.*	*Dipping.*
White clay, ſpar, quartz.	Silver.	In the hanging					
White clay, quartz, ſpar.		Eaſt to Weſt.		Coarſe clay, ſpar			

Quicken the veins.

	Name of the Place and Mine.	Mountain, or Sides of the Vein.	VEIN. Rock.	Ore.	Direction.	Dipping.
	Joachimſthal, in Bohemia					
NORTHERN VEINS.	1, Gold-roſe hading	Slate, grey micaceous	Clay; red hornſtone or flint; clay ſlate; ſpar; quartz.	Silver, lead, cobalt, arſenic: rich ores.	South to North, h 1. $6\frac{1}{4}$ p	Eaſt to Weſt, between 54° 78°.
	2, Gold-roſe hanging.	Ditto.			h. 12. $5\frac{1}{2}$.	Ditto.
	3, Fund-grub.	Ditto.	Ditto.	Ditto.	h. 12. $6\frac{1}{2}$.	Ditto.
	4, Baker's Vein.	Ditto.	Ditto.	Ditto.	h. 7. $7\frac{1}{2}$.	Ditto.
	5, Geſhieber.	Ditto.	Ditto.	Ditto, ſilver native in the croſs	h. 10. 4 p.	Ditto.
	6, Roſe from Jericho	Ditto.	Ditto, and red ſpar, in the croſs.	Ditto, and glaſs and red ſilver ore: in the croſs.	h. 2. 3 p.	Ditto.
	6, Sweitzer.	Ditto.	Ditto.	Ditto.	h. 1. $2\frac{1}{4}$.	Ditto.
	7, Young Sweitzer.	Ditto.	Ditto.	Ditto, and native ſilver and glaſs ore N. B. The ores, and the richer ones, chiefly in the croſſes of the following Eaſtern veins.	h. 2. $4\frac{1}{4}$.	

CROSS VEINS, *or* CROSS JOINTS.

Improving.				Cutting of, or striking dead.			
Rock.	*Ore.*	*Direction*	*Dipping*	*Rock.*	*Ore.*	*Direction*	*Dipping.*
Trapp.		East to West.	South to North				
Trapp.		Ditto.	Ditto.				
Trapp.		Ditto.	Ditto.				
Porphyry, fat clay		South to North					
All the above Northern veins are beſides conſtantly improved by the crofſings of the Eaſtern ones, which run from Eaſt to Weſt.				Porphyry		South to North	
				Porphyry		South to North	

	Names of the Place and Mine.	Mountain, or Sides of the Vein	Rock.	VEIN. Ore.	Direction.	Dipping.
	Joachimſthal, in Bohemia					
EASTERN VEINS.	1, Lawrence.	Slate gray micaceous	Clay, clay ſlate, ſpar, and quartz.	Silver, lead, cobalt, arſenic: rich ores.	Eaſt to Weſt, h. 5. 1½ p.	South to North, between 60. 73′.
	2, Suſanna.	Ditto.	Ditto.	Ditto.	h. 6 ¼.	Ditto.
	3, Vrſula	Ditto.	Ditto.	Ditto.	h. 6 6¼ p.	Ditto.
	4, Andreas.	Ditto.	Ditto.	Ditto.	h 7 2¼ p	Ditto.
	5, Cow Vein	Ditto.	Ditto.	Ditto, and ſilver native glaſſ ore, lead-glance.	h. 7.	Ditto.
	6, Roſe Vein	Ditto.	Ditto.	Ditto.	h. 6 ¾ p	Ditto.
	7, Elias.	Ditto.	Ditto.	Ditto.	h 7 ½ p	Ditto.
	8, George ſtoln.	Ditto.	Ditto.	Ditto. N. B. The ores and the richer ones chiefly in the croſſes of the above Northern veins.	h. 6 3¼ p	Ditto.

CROSS VEINS, *or* CROSS JOINTS.

Improving.				Cutting of, or striking deaf.			
Rock.	*Ore.*	*Direction*	*Dipping.*	*Rock.*	*Ore.*	*Direction*	*Dipping.*
				Trapp.		East to W	South to N.
				Porphyry		South to N.	East to W.
				Trapp.		South to N.	
				Trapp.		East to W	South to N.
				Porphyry		South to N	
				Porphyry		South to N.	

N. B. The above Northern veins croſs and improve the Eaſtern ones.

TRAVELS

THROUGH THE BANNAT OF

TEMESWAR, &c.

LETTER I.

Temeſwar, June 14, 1770.

MY journey from *Shemniz* to this place has ſcarce offered me any object that might make this letter agreeable to a naturaliſt of your caſt. Had I, beſides my little mineralogical ſcience, ſome knowledge in Botany, my three days travelling over barren heaths from *Ofen* to *Segedin*, and thence to *Temeſwar*, might have perhaps procured me an opportunity to entertain you at leaſt with the names and deſcriptions of ſome plants. But alas! I am no Botaniſt, tho' that is not my fault. You well know how fond I am of natural hiſtory. But I never met with any proper oppor-

tunity to improve in this part of ſcience. Except at *Vienna*, there is no academy in all the *Auſtrian* ſtates, in which Botany is taught; nay, even at *Vienna*, there is no Profeſſor of Natural Hiſtory. For this reaſon you need not be aſtoniſhed that natural hiſtory is entirely unnoticed and neglected in *Auſtria*, while the *Engliſh*, *French*, *Swedes* and *Ruſſians*, for the ſake of uſeful ſcience, examine their own and the remoteſt countries of the world. But to what purpoſe theſe complaints? You may gueſs by them the diſſatisfaction, which will attend me on my journey through the mountains of *Bannat*, *Tranſylvania*, and part of the *Carpathian hills*. All the riches of *Flora*, during the fineſt ſeaſon of the year, diſplayed in theſe parts, will be ſcarce at all enjoyed by me. However, I do what I am able to do, and I repeat my former promiſes, that you ſhall have a ſhare of the minerals which I collect, and accounts of the nature of the mountains, and the working of the mines, which perhaps may be new to you.

From *Shemniz* to *Ofen* the mountains conſiſt of the ſame argillaceous rock, which is mixed with quarz, ſherl and mica, and compoſes the whole maſs of mountains about *Kremniz* and *Shemniz*. In ſome places, and eſpecially at *Deutſch-Pilſen*, they have likewiſe diſcovered ſome copper and ſilver-veins, drained ſome old and drove ſome new

new galleries; but to no great advantage. All theſe mountains are covered with argillaceous ſlate and limeſtone.

Near *Waizen*, a handſome little city on the *Danube*, begins the plain, which uninterruptedly ſtretches thence to *Temeſwar*, and to the left hand to *Debreczin*, and the limits of *Tranſſylvania*. In three hours I came to

Peſt, where I ſpent a day. This city, adorned with magnificent ſtructures in the neweſt taſte, is entirely built of petrifactions. The quarry, whence they fetch the ſtones, is near *Ofen*, a city directly oppoſite on the other ſide of the *Danube*. I examined theſe calcareous hills, productive of the beſt wine of *Ofen*. They conſiſt of a porous limeſtone, which is filled with innumerable quantities of chamites, turbinites and pectinites. Our *Walch's*, *Schrotters* and *Hupſches*, with ſeveral other gentlemen of that kind, who are affraid of coal duſt, and the horrors of ſmutty mines, and hunt after petrifactions only on the ſurface of the earth, might in this place make rich crops; nay, they might perhaps, from this immenſe ſtock of ſhells, pick up ſome chamites or pectinites, with ſome unknown undeſcribed ſtripes, wrinkles, folds, warts and points; and then, mercy upon our ears! how they would indulge themſelves in God knows what analogy or ſimilarity; in forming far fetched

names, and ſinging forth the praiſes of their important diſcoveries! To us ſimple mineralogical folks it is ſufficient to have found here marks of an ancient ſea's covering this part of *Europe*.

The hot baths at *Ofen* are ſpoken of by all geographers. Mr. *Laurentius Stocker* deſcribes them at large in his *Thermographia Budenſi*. According to his account, their conſtituent parts are ſulphur, lime, and iron.

Beyond *Ofen* begins the famous *Ketſkemite-heath*. It is all over covered with grit ſand (glarea Linnaei) mixed with broken ſea ſhells. The ſtones which now and then appear ſtraggling, are ferruminated by this ſand. I travelled often ſix hours and longer without meeting with any tree or houſe, except the ſtage houſes. However this plain, fifty *German* miles ſquare, feeds vaſt quantities of cattle. Near *Debreczin* they dig out of ſome ſwampy grounds of this heath the *Sal alcali minerale nativum*, mixed with ſome clay. For many years they have made of it the excellent *Debreczine* ſoap, which ſells over the whole kingdom. In former times they conſidered this as a common ſaliter. Mr. *Stephen Weſzpremi*, a celebrated phyſician at *Debreczin*, and Mr. *Juſt John Torkos*, were the firſt who examined it. The former ſpoke of it in his

Tentamine de inoculanda peſte. Londini, 1755.

and

and the latter in his treatiſe

De ſale minerali alcalino nativo Pannonico. Poſonii, 1763.

I heard lately from *Vienna*, that a young phyſician, Mr. *Gabriel Pazmandi*, from *Comorra* in *Hungary*, has publiſhed a new treatiſe on this ſalt, its native ſituation, qualities and powers.

I obſerved on this heath ſome flocks of large eagles, and ſome birds in the ſwamps, which were unknown to me, and may be perhaps for want of a proper deſcription, or a ſcentifical zoologiſt to obſerve them, uninſerted and unnoticed in the ſyſtematical catalogues of birds.

Beyond the *Theiſſa* (*Tibiſcus*) and as ſoon as I left *Turkiſh Cariſha*, the ſoil appeared richer and more entertaining. Here are plantations of trees, corn-fields, and plenty of colonies, whoſe eſtabliſhment coſts to our imperial queen immenſe ſums annually.

The villages are built upon a regular plan; the houſes, for want of wood, built of unbaked bricks, and thatch'd with reed (arundo.) They have generally a parſon, a ſchool, a corn magazine, and an accountant or inſpector. Every coloniſt receives at his arrival a ſuitable houſe, the tools of huſbandry, the houſhold implements, ſome horſes, and a piece of ground. After ſome years he gives the tithe of his crop as a contribution, and

then he may pay every year what he can afford of the whole property.

A good huſbandman is ſure to proſper here. Perhaps it might have been made more eaſy to them if the villages had been planned ſmaller. There are ſome that contain 3 or 400 houſes. As every coloniſt is poſſeſſed of a large waſte ground, which he is to cultivate, many of them have an hour's ride before they can reach it.

LETTER

LETTER II.

Temeſwar, June 17, 1770.

YOU know that two years ago I travelled in this country; beſides I was born in *Tranſſylvania*. I have therefore materials for a letter, which may for the want of natural hiſtory, if not pleaſe, at leaſt entertain you.

The *Bannat* of *Temeſwar* is that tract of land in *Hungary*, which in the *Homannian* maps is found under the title of the *Cſanader* or *Temeſer* county. It is under the 45th degree northern latitude, is 22 *German* miles in length, and 15 or 16 in breadth. Its boundaries are to the north the river *Maros*, to the weſt the *Theiſſa*, to the ſouth the *Danube*, and to the eaſt tremendous chains of rocks, which ſeparate it from *Tranſſylvania* and the greater *Wallachia*. But on this ſide it joins to the continent; in reſpect of the other ſides it is a peninſula. It is divided into eleven diſtricts or bailiwicks, viz. that of

Cſanad, of *Czakova*, of *Szent Andraſh*, of *Szent Mikloſh*, of *Beczkerek*, *of Uy Palanka*, of *Verſhez*, of *Orſova*, of *Caranſebez*, of *Lugoſh*, and of *Lippova*. Every diſtrict is ſubdivided into ſmaller ju-

riſdictions, which are called proceſſes. A bailiwick conſiſts of the bailiff, a comptroller, two or three under bailiffs, a ſcrivener, ſome advocates and upper-kneſes, which are a ſort of national magiſtrates. All theſe bailiwicks are immediately under the country-adminiſtration, and this under the royal court chamber-deputation at *Vienna*. The *Bannat* being a domanial eſtate of her majeſty, is entirely independent of the *Hungarian* ſtates. The chief town and the center of the country is *Temeſwar*, a regular, fine, and ſtrong place, but unwholeſome on account of its ſwampy ſituation. Agues and inflammatory fevers of all kinds rage here every ſeaſon, and procure to the phyſicians uninterrupted buſineſs.

Here is the general government, the country adminiſtration, the provincial court, the chapter of *Cſanad*, whoſe biſhop is by his own right *primus inter pares* in this country, and two patentee-commercial companies for the *Auſtrian* ſea-ports in Italy. The whole eaſtern part of the country is mountainous and beſt inhabited; the weſtern part is flat and ſwampy. In this are large uncultivated plains, which government takes care to plant with *German* colonies from the *Swabian* and *Rhiniſh* circles. On the four corners of the country are ſome ſtrong places, ſuch as *Caniſha*,

Semlin,

Semlin, *Mehadia*, and *Lippa*. *Szegedin* and *Arrad*, ſituated on the other ſide of the *Maros* and *Theiſſa*, are *Hungarian* dependencies. None of theſe four places are remarkably ſtrong. However, they are celebrated in the hiſtory of the *Turkiſh* wars, as are likewiſe *Panſowa*, *Uy-Palanka*, and *Orſowa*. The rivers in the *Bannat* are of no importance, as running only through a ſhort tract of land; but the *Temes* and *Nera* deſerve notice, the former being made navigable down to *Peterwardein*, by an expenſive canal, drawn from *Lugoſh* to *Temeſwar*.

The ſoil is extremely fertile. The wine is in many places excellent. It is generally of a red colour. Peach, cherry, and plum trees are very common. Large plantations of that kind ſkirt the villages and provide the inhabitants with their drink. The ſilk plantations ſpread almoſt over the whole country; they might, like many other manufactories of the bannat, be in a more flouriſhing ſtate, if that great general and politician Count *Mercy d'Argenteau*, had lived to ſupport them.

Of late there has been raiſed in this country a national-militia, which in the imperial and royal military ſtate goes under the name of the *Illyrian* regiment. It is commanded by the lieutenant-colonel

colonel Baron *de Sezugaſs*, knight of the *Thereſian-order*, a man who has greatly ſerved his country. Not ſatisfied to have corrected the rough behaour of his officers, and to have habituated them to the *German* manners, he endeavours likewiſe to humanize his private men. He eſtabliſhes ſchools and maſters, and the ſoldier is obliged to have his children ſent there. If we had a calendar of political ſaints, Baron *Sezugaſs* would ſhine in it, under the title of the *Illyrian Reformer*.

The *Plajaſhes* are another ſort of national troops, poſted on the limits of *Tranſſylvania* and the greater *Wallachia*, from *Marga* towards *Orſowa*, to put a ſtop to tranſmigrations, and to prevent the eſcape of the *Turkiſh* and inland robbers. They are under the command of captain *Peter Vanſha*, who in the laſt *Turkiſh* war was *Haran-baſſa*, or chief of a numerous gang of robbers, and deſerved his fortune for having in the laſt war ſaved the late emperor at *Cornua* from the imminent danger of being taken priſoner by the *Turks*.

This nation is remarkable for having produced many brave men of great deſert. Captain *Ducca* for examble, a man of eighty years of age, has in the late *Turkiſh* war been of eminent ſervice to the court; however, he never has ſolicited or received any preferment, happy in the conſciouſneſs of

of his honeſt ſervices, and of his maſter's grateful diſpoſition. I will in one of my letters deſcribe at large the character, the manners, and the religion of the inhabitants. At preſent I add only an abſtract of my yeſterday's tranſactions and buſineſs.

Soon in the morning I was awakened by a diſmal and frightful rattling of chains, which ſounded all along the ſtreet where I have lodgings. It was occaſioned by the malefactors, condemned to the fortifications, who, by couples chained together, went to work. I did not ſee in the ſtreets any but bleak, yellow-coloured, decayed faces, peeping and iſſuing forth from the fineſt buildings. The women, even the girls, had thick ſwoln bellies, left them by the fevers. I fancied myſelf in the realms of death, inhabited, inſtead of men, by carcaſes in fine tombs. At dinner all the gueſts, beſides me and ſome foreigners, had a fit of their fever; ſome freezing, gnaſhed their teeth; ſome burning for heat, could not aſſuage their thirſt. In the afternoon I viſited the canal which I ſpoke of before. I ſaw there ſome hundreds of bee-hives conveyed to the meadows, and to the heaths, where the bees are left for paſture during the whole ſummer. Each ſet of ſixty hives has a bee maſter to take care of them. The hives are conſtructed

of

of eleven thin pieces of deal, three inches thick, and at one end decreaſing into a point. They are joined by willow or birch branches into a hollow cone, open at the bottom. Two or three inches above the ground there is a ſmall opening, and within ſome croſſes of wood, on which the bees ſuſpend their work. But they behave in *Hungary* with ungrateful cruelty to theſe laborious inſects, ſince, to take out the honey, they puſh the hive with violence againſt the bottom of a tub, which brings down bees, wax and honey in horrid confuſion, the whole to be maſhed and cruſhed into a ſweet but diſguſtful mixture.

In the evening I viſited the publick goal, where I ſaw a famous robber, who, during the laſt ſummer, had greatly annoyed the *Turks*, and by particular deſire of the Grand-Signor is kept here, as they told me, till the end of the war. He is a young, well dreſs'd, and handſome man. He was formerly a rich merchant in *Servia*, and became a robber to revenge upon the *Turks* ſome violences which they had offered to him and to his family. His determined, bold, phyſiognomy, and his raſh undertakings, in which he was very ſucceſsful, raiſed in me the idea, that perhaps he might have proved an *Alexander*, if he had been born to attempt with greater forces, what he neither

ther dared, nor is any other perſon permitted to attempt, with ſmaller ones. All this will eaſily convince you that my ſtay in this place cannot be agreeable to me. But the buſineſs of my companion layeth me under the neceſſity to ſtay ſome days more. Therefore, if you be happy, remember your friend in *Pontus*.

LETTER

LETTER III.

Temeſwar, June 20, 1770.

THE inhabitants of Bannat are *Raizes*, *Wallachians*, and a fourth part *Germans*.

The *Raizes* are ſaid to be originally a *Scythian* people, in former times inhabiting *Dacia*, now called *Servia*. They call themſelves *Srbi*. Their language is a corrupt *Sclavonian* or *Illyric* dialect.

The origin of the *Wallachians* is leſs certain. They call themſelves *Romun*, a word which in their language equally ſignifies a *Roman* and a *remaining man*, and makes it doubtful whether they be remaining parts of *Roman* colonies, or of a people conquered by the *Romans*. The *Roman* medals, tombs, and other monuments, found in the mountainous parts, and near the *Danube*, are valuable evidences of their having been in former times ſubjects to the *Romans*, either in the one or in the other ſenſe. Even their language, which in greater *Wallachia (Zara more)* is ſpoken very rudely, but in *Tranſſylvania (Ardellia)* has the reputation to be ſpoken very elegantly, is a corrupt *Latin*. However, I do not conceive how ſo many

many *Italian* words, ſuch as *rame* (copper) *mangar* (eat) and many more, that have no ſimilarity with the *Latin*, came to be uſed by them. The termination of their words in general, and the conjugations after the *Italian* manner, have been mixed into the language of this nation.

Their manner of living is extremely rough and ſavage. They want religion, arts and ſciences. Their children are from their firſt infancy waſhed every day in the open air, in warm water, and then ſwathed in coarſe linnen or woollen cloth. The difference of the ſeaſons and the weather makes herein no difference. From the fifth to the twelfth or fourteenth year of their age they are left with the herds and flocks to attend them; however, the girls are taught in the ſame time waſhing, baking, ſpinning, making needle-work, weaving, and ſo on. From the 14th year they are brought up and employed in huſbandry. Kukuruz or maiz is their chief object of agriculture. However, they ſow likewiſe oats, barley and corn. They diſtil from the fruits of trees, which they plant in great plenty, a ſort of brandy, called rakie, which they are very fond of. Their meat is as ſimple as their dreſs. Biſquet of coarſe grinded maiz, baked under aſhes, which they call malai, ſome fleſh, milk, cheeſe, beans and other vegetables, are their common food. Their dreſs is

various;

various; but generally it conſiſts of the following articles. The men wear long white woollen trouſers, as the *Hungarians*, but wider; ſoles of raw ſkin tied about the feet inſtead of ſhoes; a ſhirt open on the breaſt; a woollen jacket or coat, tight around the waiſt, with long ſleeves, and a fur cap or bonnet for the head. The women have long ſhirts down to the ancles; a brown variegated ſtriped petticoat open on both ſides, and tied with a girdle; a waiſtcoat or garment of coarſe cloth, ſomewhat ſhorter than the ſhirts, and an annular bolſter ſtuffed with hair or ſtraw upon their head, which they cover with a woven cloth. The girls go bare headed. Their ornaments conſiſt of ear-rings of white or yellow braſs, of coloured glaſs, beads, pearls, glaſs feathers, and pieces of money faſtened to a ſtring and tied around the head and the neck. This ornament makes a ringing, ſo that a fine dreſt'd *Raize*, or *Wallachian* girl, may very often be heard ſooner than ſeen. They marry very young; and there are married couples, the man not above fourteen, the wife even not twelve years of age. Some manual arts ſeem to be peculiar to them. Scarce any where you will find a cartwright, or a weaver; every *Wallachian* being a cartwright, and every woman a weaver. No woman is ſeen going about without ſome work in hand. What they bring to ſale they

they carry on their heads. If they have a child to nurſe, it is carried in the ſame manner. The ſpindle is ſticking in their girdle, and all the way they are ſpinning. All their neceſſaries are worked up by themſelves. Scarce any tradeſmen nor any beggars are ſeen among them. What can I ſay to you of their religion? They confeſs the non-united *Greek* religion, *Græci ritus non unitorum.* But in fact they have ſcarce more religion than their domeſtic animals, except repeated faſtings, which almoſt take up half the year, and are ſo extremely ſevere, that they dare not eat any meat, eggs, or milk; they ſcarce have any idea of other religious duties. But in theſe faſtings they are ſo ſcrupulous, that they do not break them, even ſhould they ſlight every other divine or human law. A robber will never indulge himſelf contrary to this abſtinence, nor lie with his own or another man's wife, for fear that God might in this caſe withdraw his bleſſing from his trade. What barbariſm! what humiliating ideas of the Supreme Being! The ignorance and ſuperſtition of the *Bonzes* cannot poſſibly be above that of their Popes. Some of them are ſo ignorant as to be unable to read; what can they teach the poor people? They plow and till their ground, they attend their herds like other peaſants, deal in every trade as *Jews*, and get drunk at the expence of their ſtupid pariſhioners, who ſell them their ſins, and

fancy to be happy and to be ſaved if they diſcharge their own and their deceaſed relations ſins at a good price. The ſalutary ordonnances, which her majeſty the queen has publiſhed againſt the illicit tricks of theſe Popes, have proved hitherto uneffectual to reſcue the people from that ſpirit of ſlavery wherewith they are ſubject to theſe ſpiritual maſters. Her majeſty's wiſdom is equally eminent in protecting and propagating true religion, as in checking and extirpating ſuperſtition.*

The religious rites and ceremonies of this people ſavour rather of Paganiſm and Judaiſm, than of that religion which they profeſs. For example; no woman will attempt to kill any animal whatever it be. The bride is on her wedding day, and the day before, conſtantly hid under a veil. Whoever unveils her is entitled to a kiſs; and, if ſhe deſire it, obliged to make her a preſent. The women are in the churches ſeparated from the men. Their funerals are ſingular. The corpſe is with diſmal ſhrieks brought to the tomb, in which

* The above inſtance of her majeſty's maternal care for her much-beloved, faithful, and loyal Hungarian ſubjects, who, in the beginning of her reign, unanimouſly declared, *Moriamur pro Rege noſtro Maria Thereſia!* is, indeed, a new laurel added to the glory of Auſtria, by ſo many victories over the Turks; and of late, by ſo many admirable laws and eſtabliſhments for the improvement of commerce, trade, and huſbandry, fixed for the lateſt poſterity.

which it is ſunk down as ſoon as the Pope has done with his ritual. At this moment the friends and relations of the deceaſed raiſe horrid cries. They remind the deceaſed of his friends, parents cattle, houſe and houſhold, and aſk for what reaſon he left them. As no anſwer enſues, the grave is filled up, and a wooden croſs, with a large ſtone placed at the head, to avoid the dead becoming a *vampyr*, or a ſtrolling nocturnal bloodſucker. Wine is thrown upon the grave, and franckincenſe burnt around it, to drive away evil ſpirits and witches. This done they go home; bake bread of wheat flower, which to the expiation of the deceaſed they eat, plentifully drinking to be the better comforted themſelves. The ſolemn ſhrieks, libations of wine and fumigations about the tomb continue during ſome days, nay even ſome weeks, repeated by the neareſt relations. The funeral of a bridegroom is ſtill more ſolemn. A pole, ſome fathoms long, is fixed to his tomb, and the bride hangs on it a garland, a quill, and a white handkerchief. They avoid going into our churches: If by accident the get there, they purify themſelves afterwards by ablutions. To be ſprinkled in our churches, or to undergo any ceremonies with conſecrated water, is a matter of the greateſt horror to them, becauſe it is ſprinkled about with an inſtrument made of pork-briſtles

(aſpergillum.) This makes them, according to their opinion, highly impure (*ſporcat*, as they call it.) Even their dreſſes ſuffering by ſuch an accident cannot be worn again without waſhing. Their Popes diſtribute the conſecrated water by a branch or noſegay of hyſſop, according to the Pſalm: (*Aſperges me hyſſopo.*) For a long while I did not underſtand what the *Wallachians* meant by *Frate de cruce*, or *Mangar de cruce*. At laſt I have learnt it. If they engage themſelves in an indiſſoluble friendſhip in life and death, they put the form of a croſs in the veſſel or the cup from which they eat or drink; ſwearing everlaſting fidelity. This ceremony is never to be ſlighted. It is generally a previous rite to robberies. The ſame ceremony is reſorted to as the moſt efficacious bond; for example, if robbers releaſe a man, by whom they apprehend to be indicted, they oblige him to ſilence by an oath by the croſs, the ſalt and the bread, which they call *Giurar pe cruce, pe pita, pe ſare*. Their canon law is very different from ours. Stealing and adultery are conſidered as trifling crimes; but violating or diſhonouring a girl are great ones. No murther can be diſpenſed with by their popes. That diſpenſation is reſerved to God alone. However, robberies and murthers are extremely common among this people. The reaſon is obvious. They have no true ideas

ideas either of God or of the ſoul; how ſhould not they be wrong in their ideas of the ſocial and political obligations of man? Any phænomenon, or effect of unknown cauſes, is conſidered by them as a miracle. They look upon a ſolar eclipſe as a fray of the infernal dragon with the ſun; for that reaſon, during an eclipſe, a great firing is heard through the land, to frighten away the dragon, which elſe might conquer and devour the ſun, and plunge the world into eternal darkneſs. The inſects which in the ſpring creep forth from under a rock near *Columbacz* on the limits of the *Turkiſh* dominions, and which greatly annoy their herds, are according to their opinion vomited by the devil. The holy knight, *St. George*, is ſaid to have cut off his head in a cavern under that rock. A *Wallachian* will never cut a ſpit of beech to roaſt his meat on. The reaſon is, beech yields in the ſpring a red ſap, and the ſentimental compaſſionate tree weeps theſe bloody tears according to the learned and profound obſervations of the *Wallachians*, becauſe the *Turkiſh* bloodhounds uſed to cut the ſpits for roaſting Chriſtians from beechwood. No capital puniſhment is in greater abhorrence amongſt the *Wallachians* than that of the rope. The pale and wheel ſeem preferable to it. But why? A rope ties the neck and forces the ſoul out downwards. They call that a moſt diſguſtful

impure defilement of the ſoul, and I call their ſingular nicety on that account true pſychological materialiſm.

Superſtition being the daughter of folly, you may eaſily gueſs by the above inſtances how remarkably ignorant they are. Aſk an old *Wallachian* what age he is? He will anſwer at the ſiege of *Belgrad* or *Temeſwar*, at the concluſion of the peace, or when that prince died, or that metropolitan was elected, I attended the ſwine or the ſheep, I went into the field, I married, and ſo on; and then you may caſt up his age. They are not generally acquainted with the value of the current money. Even its denominations are not taken from their own language. A dollar, or thirty groſhes, is called *leu*; a florin, *florint*; a half florin, *dult*; five groſhes, a piece of their currency, is called *Strimbe*; half a dollar, *tri ſtrimbi*. They have ſcarce any knowledge of the meaſure of liquids. The contents of a veſſel is eſtimated according to the weight of the liquid contained in it. Their weight is the *occa*, a *Turkiſh* weight, anſwering to our two pounds and an half. One *occa* contains four *litre*, one *litra* an hundred *drams*.

The difference in the character of the *Raizes* and *Wallachians* is nearly as follows:

The *Raize* is fierce, proud, bold, cunning, a friend

friend of trade, fit to be a ſoldier. His Popes leſs ignorant than thoſe of the *Wallachians*.

The *Wallachian* has no idea of haughtineſs, is a better huſbandman, a friend of eaſe, and abhoring military life. They agree in being born robbers and ſlaves to their popes and national magiſtrates. The *Greek* alphabet is uſed by both theſe nations, but they give to ſeveral letters a different ſignification. However imperfect this ſketch may be, it will do to give you ſome idea of a nation, which, as far I know, is ſtill deſtitute of an hiſtorian, to acquaint the reſt of *Europe* of its origin, cuſtoms and manners. To-morrow we ſet out, and by the next poſt I hope to ſend you a letter, which, containing objects, nearer to our taſte, will prove more entertaining.

LETTER IV.

Oravitza, June 23, 1770.

IT is not worth while to tranſcribe to you, my deareſt friend, the *Wallachian* names of the inſignificant villages, which I paſſed between *Temeſwar* and *Oravitza*. The plain which from *Temeſwar* ſtretches to *Theiſſa*, continued ſix ſtages more, or for twelve *German* miles to *Oravitza*.

Some hours before I reached this place, I ſaw to the left of the road ſome hills, which conſiſted of ſhivery, micaceous clay, and formed the promontory. Inſenſibly we aſcended theſe hills, and reached at laſt the valley wherein the place is ſituated, from which I write to you theſe lines.

Here the argillaceous ſlate diſappeared under the limeſtone, which hereabouts covers the ſurface. As ſoon as I arrived I called on Mr. *Delius*, whom, till now, I knew only by the reputation of his ſolid learning. But I was diſappointed, the arrival of Baron *Hegengarthen*, commiſſioned to examine and to improve the mines in the Bannat, did not leave him the requiſite leaſure to favour me with his remarks on the nature of theſe mountains, which as an exact obſerver he ought to be very

very well acquainted with. However, I have found another ſkilful miner, who yeſterday evening gave me ſome particulars of the general diviſion and other circumſtances of the Bannat-mines. This has furniſhed me with the materials of this letter.

A line drawn from north to ſouth through *Temeſwar*, divides the whole country into two parts; that to the eaſt is generally mountainous, and here you are only to ſearch for mines. As often as I ſpeak to you of their ſituation, it will conſtantly be in relation to the chief place, which is *Temeſwær*. The mines now working in the Bannat are to the eaſt, the ironworks *Bogſhan*, properly *Paſſioven*; cloſe to which is the new eſtabliſhed iron-works *Reſhiza*. Thence ſomewhat more to the ſouth, are the copper mines *Dognaſka*, farther off, *Oravitza*, *Saſka*, and entirely to the ſouth, *Boſniak*, or *New-Moldava*. In the plains bounded by the mountains of *Oravitza*, *Saſka*, *Boſniak*, and thoſe which run along the *Danube* and make the eaſterly limits, they waſh Gold from the *Nera*, and *Meniſh-rivers*, nay every where from the ground which is adjacent to them. In former times private companies carried on theſe waſh-works in the *Karanſebeſe-Diſtrict*, at *Konigſeg*, and in other places; ſome are ſtill going on.

All

All these mines are divided into four mountain-districts, which are called *Berg-Aemter*; such are that of *Bogshan*, to which *Reshiza* is to belong for the future; that of *Oravitza*, that of *Dognazka*, and that of *Saska*, to which is incorporated the market-town *Moldova*. They are under a direction, in which the president of the country generally presides. In former times it was at *Temeswar*; but for the future the president, a counsellor of the reports, and a secretary of this direction, are the only persons ordered to reside there. The other members, and whoever belongs to the chancery and the accounts are to reside at *Oravitza*. The mines near *Gross-Wardein*, and the bailiwick *Reszbania*, in *Upper Hungary*, are under the same direction.

LETTER

LETTER V.

Oravitza, June 26, 1770.

ORAVITZA, as I have told you, already is the chief place of mines in the Bannat. The mines of its dependency were worked by the *Turks* as long as it was under their dominion; but with leſs profit than at preſent. After the reſtoration, the old mines were drained at the expence of the imperial treaſury, and ſome new ones ſet at work; but all theſe mines, the royal galleries (ſtolln) excepted, were left afterwards by grant to ſeveral private companies, under ſeveral conditions and reſervations, which being merely œconomical, the tranſlator ſuppoſes to be unentertaining, and uſeleſs to the *Engliſh* public.

LETTER

LETTER VI.

Oravitza, June 27, 1770.

THE valley wherein *Oravitza* is ſituated, is bounded to the ſouth by the *Wadarna*, *Cſiklova* and *Temeſe* mountains; but to the north by thoſe of *Coſhowiz*, *Dilfa*, and *Cornudilfa*. The mountains are here, as generally in the Bannat, gently aſcending, and grown over with beech, birch, fir, aſh and oak. Their rocks are argillaceous, mixed with ſherl, mica, and feldſpath; and this is covered either with argillaceous micaceous ſlate, or with a fine arenaceous or lime-ſtone. Between theſe laſt ſorts of ſtones occur the copper-fiſſures (*Klufte*) which really deſerve this denomination rather than that of veins, ſince they have neither a conſtant dipping nor a conſtant run. There has not yet been diſcovered at *Oravitza* any fiſſure, running or dipping above fifty fathom (*Klafter.*)

I have examined the *Coſhowiz* mountains, and found in them the following mines: *Rocchus*, *Eraſmus*, *Jacobus*, *Benedictus*, *Gabriel*, *Paulus*, *Genovefa*, *Philippus*, *Maria*, *Maria Thereſia*, or the *Goldſhurf*, *Ladiſlai*, *Pyrite-mine*, and the *Kies-ſtock*, where a hundred weight (1. centner) yields ſeventy pounds

pounds of ſtone or lech. Theſe mines are for the moſt part drained by a gallery (erb-ſtolln) which is driven in the field above 229 fathoms, and runs 19 fathoms below them. *Rocchus* is the richeſt; and on this account the chief gallery is driven to the ſouth. Several drifts of ſmaller galleries ſerve to ſearch and to work out the ſmaller fiſſures. The hanging ſide is limeſtone, the hading ſide ſlate. So it is likewiſe in the other mines, in theſe and the *Wadarna*, *Cſiklova*, and *Temeſe* mountains, with the ſingle difference, that according to the different ſituation of the mines, the limeſtone is either on the hanging or on the hading ſide, and that the ſand-ſtone is often in the place of the ſlate on the oppoſite ſide of the fiſſures. The *Gang-rock* (that is to ſay the rock which fills the fiſſures) is for the greater part either calcareous or ſelenitic. The purer and the more ſparry it is, the richer the ores contained in it.

I was very glad to be here convinced by my own experience of what Mr. *Delius*, in a *Vienna Magazine*, has publiſhed on the origin of the metallic fiſſures, and laid down as axiomatical rules for the mines in the Bannat; that is to ſay, that the metallic fiſſures are never to be found in the rocks, but between two different ſorts of rocks. Full of this opinion I examined the *Cornudilfa* mountains, where in the *Trinity* mine I was aſſured of the hanging ſides being lime-ſtone, and of the hading

hading ſides being horn-ſtone. However, I took with me ſamples of theſe ſtones, as I uſed to do, and trying them with ſteel and aquafortis, I found that they are common grained lime-ſtone, and that the miners had denominated one ſpecies horn-ſtone, for its being finer grained and harder. This erroneous denomination of the miners may propably have led Mr. *Delius* to the above erroneous aſſertion. The ſame is obſerved in the other mines of the *Cornudilfa* mountains which are entirely calcareous; and in thoſe of the *Dilfa* mountains, where generally the finer lime-ſtone goes under the falſe denomination of horn-ſtone. The gang or vein rock, in theſe *Cornudilfa* and *Dilfa* mines, is either granulated white or yellow gypſum, or ſelenitic ſpar, which by a light warming gets a phoſphoreſcence in the dark. The fiſſures of the *Cornudilfa*-mountains have a more even direction than in the others; but in *S. Servatius*, a mine working in theſe mountains, all the fiſſures are cut off by a brown argillaceous vein.

The *Wadarna*, *Cſiklova*, and *Temeſe* mountains and fiſſures agree in general with the *Coſhowiz* mountains deſcribed before. One of the *Wadarna* mines, called St. *Paul's converſion*, yields ſome ſilver and arſenical-copper ore. I would not tire you with the liſt of the many mines which in all theſe mountains are working.

The

The common ores dug at *Oravitza* are a pale, yellow, copper pyrites; *pyrites cupri pallide flavus Cronſtedts*, §. 198. Blackiſh grey, copper pyrites; *pyrites cupri griſeus*, *ibid.* The laſt is often variegated in the ſurface. A ſpecies of pyrites, penetrated and incruſtated with a brown copper mulm, is called broth ore *(Brüherz.)* It is found in *Trinity* mine, in the *Cornudilſa* mountain. This ochraceous ore is probably owing to a decompoſition of the copper pyrites. The white arſenical copper ore, deſcribed by *Cronſtedts*, §. 199, is common in the *Wadarna* mine, called St. *Paul's converſion*; but leſs white than that which breaks in *Herrn-grund*, in *Lower Hungary*.

In the ſame *Wadarna* mountains they found, twenty years ago, in St. *Anthony's* pit, beautiful *malachit ore*. *Ochra, veneris, calciformis, impura, indurata*. I could get no ſpecimens of it; but they brought me from *Trinity* mine a fine *chryſtaliſed azure copper*. The cryſtals are oblong, quadrangular, truncated. But to my ſtill greater ſatisfaction, I got here many pieces of *red copper mulm (Ochra, Cyprii, Linn)* either diſſolved in looſe duſt, or indurated and ſtaining the fingers. *Cronſtedts* has not deſcribed this ſpecies, unleſs it be that which §. 196, or 194, n. 4. he notices as found at *Sunnerſkog*, or *Oſtanberg*. It is likewiſe unnoticed by other mineralogiſts. Among ſeveral ſamples, a looſe *cinnabar red ocher*, which girts a piece

piece of native copper, is highly remarkable. Its colour ſo high, as to miſlead even the moſt intelligent connoiſſeur. If *Cronſtedts* aſſertion be true, that copper, by the loſs of its phlogiſton, may be changed into copper-glaſs, one might gueſs by the richeſt of this ocher, which is 54 pounds per hundred weight, that it is a ſolution of copper-glaſs. But it is found in ſo large lumps, that this opinion is ſcarce admiſſible. The fameneſs of the colour has cauſed this ocher to be called *tile-ore.*

The following particulars of the pay and labour of the miners are left out, as unintereſting to an *Engliſh* reader.

LETTER

LETTER. VII.

Saſka, June, 30. 1770.

FOUR hours journey from *Oravitza* to the ſouth is *Saſka*, where I arrived yeſterday before night, under a convoy of ſome *Huzzars* and *Wallachians*. The country between theſe two places is in this ſeaſon extremely fine, and offers a continual variety of orchards, cultivated fields, meadows, plains and hills. The road runs all this way over glimmery argillaceous ſlate, which is now and then interrupted by ſome rocks of a grey argillaceous ſtone, mixed either with mica or ſherl, with mica and feldſpath, or with rocks of gneiſs. *Saſka* is ſituated in a valley ſurrounded with calcareous hills, ſuperincumbent on ſlate, whoſe diſſolved parts are carried by the rain water into the valley, and incruſtate there the roots and moſſes. The copper fiſſures, or veins hereabout, run between this grey limeſtone, and a margaceous rock mixed with baſalt grains, the former being generally on the hanging and the latter on the hading ſide. I may be wrong perhaps, but I do imagine the origin of this hading ſide to have been as follows: The argillaceous grey ſtone, mixed with mica, baſalt and little quarz and feldſpath-grains,

which I ſhall call henceforth metallic rock (Saxum metalliferum) becauſe the nobler veins in *Lower-Hungary* conſtantly croſs it, and becauſe the *Saxum metalliferum Linnæi* has ſo great an affinity with it; this rock I ſay may perhaps have been incoherent ſtill, or leſs indurated when it was covered with limeſtone, and by that accident have been changed into its preſent margaceous nature. Any ſubſequent alteration or commotion, changing their former horizontal poſition into a dipping or oblique one, may eaſily have ſeparated, and ſplit fiſſures along their ſkirts, which are now filled with metallic maſſes between the calcareous hanging and the margaceous hading ſide. Theſe mines were taken up again after the reſtoration of the Bannat, about the year 1746. They worked firſt on ſome copper veins, lying open to the day. Then the *Wallachians*, who had been ſearching after mines, diſcovered ſome old pits and overgrown large bings, which proved that in former times miners had been working there. I have been ſhown myſelf in the higher mountains a great many pretty pure copper and lead ſlags, which evidence old parting-furnaces, though thereabout there does not appear any water ſufficient to work the requiſite bellows. Might not perhaps the ancients have trod their bellows, or worked them with engines? Might not they perhaps have ſmelted their ores in ſmaller furnaces with hand-bellows, in the ſame manner

manner as the *Finnlanders* and *Ruſſian* peaſants? At preſent the number of the ſeveral pits and drifts on ſmall often inconſiderable copper or lead veins is aſtoniſhing. The chief are in *the Promontory* now *Nicolas*, *Thereſia*, *Nepomucenus* and *Philip Jacob* mine. This laſt I have examined. It is one of the richeſt works at *Saſka*. The gang-rock is as generally at *Saſka* calcareous or ſelenitic ſpar, which very ſeldom alternates with quarz. In the *anterior middle mountains* is *S. Mary*, and other inſignificant ſtock works, if ſmall neſts or lumps deſerve that name. In the *upper middle mountains* are holes or quarries, whence they dig out from between the vegetable mould and the lower limeſtone a brown irony earth, which yields from two to ſix pounds of copper per hundred weight. The moſt conſiderable pit of that kind is in the higher mountains, called *Maria felſen*. It may have three or four fathom diameter on an equal depth.

Mr. *Delius*, in the above quoted Treatiſe, gives the following conjectures on the origin of this copper mulm:

" Water is endowed with the quality of de-
" ſtroying the form of metals, and reſtoring them
" to another form; I mean only to ſpeak of the
" mixture and external form of their maſſes, not
" of their conſtituent metallic particles, which are
" eternally permanent. This happens very com-
" monly to the copper ores, and generally to thoſe

" which are pyritical ; they are ſubject more than " any others to be diſſolved by water into vitriol. " Such a transformation of ores nature has produ- " ced in the mines of the Bannat near *Saſka*, where " a whole mountain has been ſubject to it. The " copper is not mineralized, but it appears as a " metallic duſt in a browniſh earth, if properly " waſhed. This earth did not exiſt from the begin- " ning in that form ; but it was rather a copper- " pyrite, which by the waters has been diſſolved. " The ſulphurous acid went off waſhed away by " the water ; but ocher and the unmetallic earth, " which are the conſtituent parts of the copper py- " rites, remained, retaining the native copper par- " ticles as a filter. This formed the *Saſka* copper " mulm." Mr. *Delius* ſupports this opinion by the copper-pyrites ſtill found in the mulm, and yet unaffected by the diſſolution ; but however probable it be, he has neglected a circumſtance which I confeſs myſelf to be ſcarce able to anſwer for. The brown copper mulm under conſideration is immediately under the vegetable mould, and its hading ſide is limeſtone. Is there any probability that theſe pyrites have been before their diſſolution without any roof or hanging ſide? If that be the caſe, the *Romans*, which, according to Mr. *Delius*, have worked in theſe parts under *Trajan* and his ſucceſſors, might have driven expenſive ſhafts and galleries, whoſe cop-

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per remains are ſtill found in theſe mines? But they had a more eaſy way of getting copper. They wanted only to get the ore immediately, and by the leaſt trouble. *

Might we not rather conjecture that theſe fiſſures, when the ancients worked in theſe parts, had then their own hanging and hading ſide together, with a different poſition; and that after a previous earthquake it has been changed ſo as to deprive theſe fiſſures of their former roof and hanging ſide, and to expoſe the ores to deſtruction? An able miner, uſed to obſerve nature, might perhaps rectify theſe conjectures, which I ſcarce am bold enough to venture, as having had no leiſure for proper examination.

Bona Spes, *Anna Roſina*, *Maria Snow*, *Mary's Viſitation* and *Bonifacuis*, in the higher mountains, are equally remarkable mines, on account of their beautiful ores; and *Saſka* is perhaps that place, which has ſupplied my collection with the richeſt crop of mineral curioſities. All the different ſpecies of copper ores, that of the *Mansfield* copper ſlate

* The tranſlator ſees not the leaſt conſequence in this whole argumentation, as theſe pyrites might have been with other rubbiſh waſhed and accumulated on the limeſtone-ground, and the ignorance or neglect of the *Romans* cannot be fairly alledged againſt the hypotheſis of Mr. *Delius*, ſince it proves too much or nothing.

excepted, and many more new and unknown ones, are dug hereabout in great plenty. In *S. Urban* I found native copper with a poliſhed ſplendent ſurface, ſticking to a matrix of clayiſh ſandſtone and quarz; and in the *New-Elias* I got native branchy and dendritical copper in white indurated clay. Native copper in looſe brown copper mulm from the before deſcribed pits in the higher mountains, and in green and blueiſh copper ocher from *Mary's Snow*, are not unfrequent. I was preſented with a ſample of native woven copper, by its texture greatly reſembling the woven ſilver, from *Johan George-Stads* in *Saxony*. This ſpecies is found in *Bena Spes*, in quartzous gangrock, mixed with greeniſh lithomarga; grey copper glaſs, *Cuprum Sulphur mineraliſatum ſolidum textura indeterminata Cronſtedt*, §. 197, is found in *Philippi Jacobi* pit. It is malleable, and of a compact texture. They call it here *lech ore*. It breaks in ſcaly grey limeſtone; yields from ſixty-three to ſeventy pounds of copper, and moulders by diſſolution into a blackgrey duſt. Red copper glaſs of an undetermined figure, *Minera cupri calciformis puru & indurata colore rubro Cronſtedt*, §. 195, found in *Maria Brunn*, in a white gypſum tinged by verdegreaſe. In the ſame place it breaks in a fibrous verdegreaſe, which makes it very beautiful to the eye. Mr. *Delius* preſented me with ſuch a cryſtallized copper glaſs, which

conſiſts

conſiſts of many accumulated red tranſparent triangular cryſtals. Theſe, and a variety of octangular cryſtals, are found in *S. Urban* and *Mary's* viſitation ſticking to an undeſcribed copper ore. It is a brown red fine grained jaſperlike ſtone, ſtriking fire with ſteel. I might by Mr. *Cronſtedt*'s example, who calls our *Hungarian* zinopel jaſpis martialis (Minerol. §. 65.) name it a copper jaſper. It contains, ſeparated from the richer cryſtals, from thirteen to nineteen pounds of copper. Some pieces mouldered into a red copper ocher, and containing in the middle only a remaining kernel of this red jaſper, convinced me that the *tile-ores*, which are dug in the ſame mine, and which I have deſcribed at *Oravitza*, owe their origin and their riches to this jaſperlike ore, and its copper glaſs cryſtals. Among a variety of verdegreaſe, *Ochra cupri viridis*, *viride montanum*, which is here very common, I received fine fibrous gloſſy copper green *Aerugo Linnaæ*. The fibres are for the moſt part concentric, pointed below but two or three inches, large and flat at the top. They call it *ſatin-ore* (Atlas-ore.) There is an innumerable variety of *malachites*, in thin flat plates, but knotty, in concentric coats, in thin undulated lamellæ and ſcales; its colours from the lighteſt to dark green in every ſort of ſhade. The *Barmaſter* in this place improved my collection by a ſample from *Reczbania*, a copper

work in *Hungary*, under the direction of the Bannat. It is an indurated fibrous verdegreaſe (*Ærugo Linnæi*) which after the tranſmutation into malachite has preſerved its original concentric fibres. Indurated *copper azure* (*Cærulcum montanum induratum. Cronſtedt.* §. 194.) and cryſtallized azure, in gloſſy ſemi-tranſparent polyedrous cryſtals, offered to me in *Urban* and *Maria Shutz* mine. I gathered here for my mineralogical friend a good ſtock of the brown and grey copper mulm. Such an indurated mulm from *Philippi Jacobi*, and other mines, mixed with ſome phlogiſton, ſmooth and gloſſy where broken, is on account of the likeneſs called *pitch-ore*. It ſeldom yields above ſeven or eight pounds of copper; but being commonly mixed with verdegreaſe, azure, cryſtallized red copper glaſs and native copper, it is generally ranked among the richeſt ores of *Saſka*. Beſides the *fallow copper ore*, *pyrites cupri griſeus. Cronſtedt.* §. 198. which they call here *white-ore*, any other ſort of copper pyrites are found in theſe mines. In the upper middle mountains they find in ſome lead pits a light brown *lead ocher*, which is often mixed with white irregular ſpar-chryſtals. The above *pitch ores* are commonly covered with blue columnar hexagonal or polyedrous gloſſy cryſtals, truncated on both ends. They never contain any copper, and are but *blue ſherl cryſtalliſations*. Mr. *Dembſher*, a very intelligent

intelligent aſſayer at *Moldova*, has aſſured me, that for a long while he had, without any ſucceſs, aſſayed theſe ores as copper ores, till at laſt he had found in *Lehman*'s preface to *Marggraf*'s works, that now and then handſome blue chryſtals had offered to him entirely deſtitute of copper, but containing plenty of iron. The only remarkable ſtones, which, beſides the different rocks I have found here, are a white tranſparent calcareous ſpar cryſtalliſation, conſiſting of columnar hexagonal cryſtals, with three large and three ſmaller oppoſite ſides and a triangular point; a dodecaedrical cryſtalliſation, compoſed by pentagonal faces, drawn in *Linneus's Amocnitatibus.* tom. I. fig. 25; and a pyramidal, triangular, tranſparent ſelenit-cryſtalliſation. As ſoon as I return I will divide my collection with you, knowing very well that they have raiſed your curioſity.

LETTER

LETTER VIII.

New Moldova, July 1, 1770.

THE daily examples of the ill uſe, which travellers in the Bannat, eſpecially in theſe parts, are expoſed to from the numerous gangs of robbers, had almoſt brought me to the reſolution to give up my journey to this laſt boundary, which is ſeparated from the *Turkiſh* dominions by the *Danube*. But I heard that theſe fine gentlemen vent their ill humour rather againſt their countrymen, which have the misfortune to fall in with them, than againſt any *German*, which is ſaid to happen but very ſeldom. This circumſtance, and my recollecting the chiefs of the robbers having ſent word to the aulic commiſſioner, Baron de *Hegengarthen*, that he and his men might in ſafety, and without any convoy, travel where he pleaſed, gave me reſolution to attempt this excurſion towards the eaſt. Twelve mine-officers on horſeback, and ſome common miners armed with guns, went with me. As ſoon as we had aſcended the higher mountains of *Saſka*, I obſerved that gneiſs, now and then cap'd with common clay-ſchiſtus and limeſtone, covered the whole

whole country. This continued to *Moldova*. Some ſmall copper veins baſſet out from the ſchiſtus. But the ſkilful miners do not work them, becauſe they dip only ſome feet in the ſlate and then ſtrike dead or diſappear entirely. Perhaps after a long ſeries of years they will diſſolve into copper mulm as at *Saſku*, and then be got eaſily by poſterity. After two hours ride we alighted at a copper furnace in the midſt of a thick foreſt. The mine-officers from *Moldova*, and about thirty armed miners, had expected me there and joined our caravan, which now reſſembled a little army. I was agreeably ſurprized to meet here with my old college acquaintance, Mr. *Demlſher*, aſſayer and engineer at *Moldova*. This young man, poſſeſſed of all the theoretical and practical ſcience of miners, of much learning and good taſte, has for ſeveral years, by our continual correſpondence, prepared me for a journey to the Bannat, and enabled me to make and to juſtify in a ſhort time all the obſervations which I have given and ſhall continue to give you. His converſation, and the merry chearfulneſs of my convoy, diverted me ſo much, that I thought of no danger in the thick woods which we croſſed to *New Moldova*. As ſoon as we arrived I viſited the town *Moldova*, at the foot of the mountains on the *Danube*, to ſee ſome robbers who had been taken by a party of ſoldiers. They had brought along with them the head of a young man, who had

had bravely fought againſt them, and preferred death to chains. In the evening I returned to *New-Moldova*, or as they call it, *Boſniak*. The fine views from the hills were extremely pleaſing. I ſaw from thence a large tract of country far in the *Turkiſh* dominions; but I did not ſee without concern the hills, which concealed from my eyes the former rich copper-works, near *Maidenbeck* in *Servia*.

To day I viſited the mines hereabout. They are divided into three diſtricts, that of *Benedicts*, *Florimund's* and *Andreas*. In the firſt are *S. Barbara*, *Trinity*, *Nepomucenus*, *God's hope*, and *fourteen Nothelfer*; in the ſecond, *Joſeph*, *Thereſia*, *Archdutcheſs Mariana*, *Pelagia*, *Maria good Rath*; and in the third, *Andrews*, *Peter* and *Paul*, *Anton* from *Padua*, *Hilarius*, *Thomas* and *Helen*. They are all working, and yield fine copper ores from veins running in almoſt every direction. *Maria Thereſia* yields lead. The hading ſide of theſe veins is grey clay-ſchiſtus; the hanging ſide is lime-ſtone; both ſuperincumbent on gneiſs. Theſe mines ſeem to have been worked in times of old; ſince the miners ſcarce have reached till now any ſound or new field, and get their ores only in the old man. The ancients have indeed left ſtupendous works in the *Beſedine* mountains, which are not worked at preſent. They have formed works with chiſſels and hammers in rocks, which we hardly

hardly conquer by blaſting. In ſome parts the walls are ſo flat and even, that they reſemble rather ſtonecutters than miners work; where they met with looſe cruſhed rocks, they left tremendous caverns. It is aſtoniſhing that the moſt ancient works are generally driven in the ſoundeſt rock. Whether they may be aſcribed to the *Romans* cannot poſſibly be aſcertained. The conſtruction of theſe old galleries and drifts has nothing particular; it agrees with what you have ſeen in the *Trinity Erb Stolln* at *Shemniz*. The doors are either cut in ſolid rock or lined and faſtened by uncemented maſonry; their figure eliptical. They work here as at *Saſka* on fiſſures, which are inconſiderable. The ores found in this place give the moſt malleable and tough copper in the Bannat. For this reaſon, and to encourage the working of the *Moldova* mountains, the imperial direction pays for the *Moldova* copper four florins extraordinary. Almoſt every ſort of copper ore which I have mentioned, from *Oravitza* and *Saſka*, are found here. *Native copper* breaks in *God's hope* in different forms. It ſticks commonly to quartz. If found on black grey copper pyrites, it moulders in open air into a calx reſembling pulverized tiles, but whitening ſtill more and more. In this ſtate of diſſolution it ſcarce yields any copper at all. The native copper from *Jchan Nepomucenus*, and *Barbara ſtolln*, are

are of the ſame nature. Red copper-calx is found in *Archduchefs Mariana* in a matrix of aſbeſtus, which contains likewiſe now and then ſome copper pyrites. In *Hilarius* I got ſome fine red copper glaſs cryſtals, and from the old bings of the *Beſedine* mountains ſuch cryſtals, and lead glance, which contain ſome ſilver.

My friend *Dembſher* aſſiſted me to get here a large ſtock of pitch, broth and clay ores, or of whatever other ſort and denomination of richer ores. With this booty I return tomorrow to *Oravitza*, to pay my laſt reſpects to Baron *Hegengarthen*, and to purſue by the road of *Dognazka* my way to *Tranſſylvania*.

LETTER

LETTER. IX.

Dognazka, July 5, 1770.

THE day before yesterday I took my farewel of Baron *Hegengarthen*, and arrived here after five hours ride. Clay-schistus, mixed with mica, cap'd the lower granite, which now and then peeped from under ground, all the way long from *Oravitza* to this place. The mountains, which are working at *Dognazka*, are middle mountains, which rise from the plains near *Werschez*, and run eastward to *Transsylvania*. The chief ridge of these mountains is granite, covered by gneiss, clay, sand and lime. The only constant vein (gang) in the Bannat is here at *Dognazka*. Its run and dipping is constant for a great while. It is situated in *John's mountains*, and consists of a lead and silver vein. They have chased it already in its run from west to east 1500 fathom, It dips from south to north. Before the last *Turkish* war they got here a good deal of silver. The following different pits, *Mary Christina*, *John* and *George*, *Susanna*, *Nepomuck*, *Barbara*, *Samuel*, *Mercy*, *Sweti Theodor*, and the *Herbestine* stoln are at present working upon it. This vein running along the

foot of the higher incumbent lime and ſlate-hills, the mines are greatly expoſed from water. For the greateſt part of the year they are under water; and though in *Maria Chriſtina* they have of late built a horſe-engine, in hopes to drain this mine, I am apprehenſive it will fall ſhort of expectation. This very circumſtance hindered me to examine theſe mines myſelf, which I ſhould have been the more inclined to do, as I cannot believe that the hanging and hading ſide of theſe veins in greater depth, but conſiſting of lime and ſlate, or of hornſtone and argillaceous ſlate. However, that is the aſſertion of the mine-officers. I have examined the rubbiſh of theſe mines, and true it is, that it conſiſted of indurated ſhivery clay and limeſtone; but as this may be ſuppoſed to have been drawn only from the upper drifts, I am ſtill of opinion, that in a greater depth gneiſs or ſherl-mixed argillaceous rock, Saxum metalliferum might be found. It is highly improbable that a conſtant quick vein ſhould have ſuch an uninterrupted run in rocks ſo accidental as theſe ſuperincumbent clay, ſlate and limeſtone hills; and I have found in an old account of the *Bannat* mines, from the year 1748, that in the then new imperial ſtoln or gallery, after it was driven through the ſlate, they reached a very hard rock, which made the work go on very ſlowly; and that in the old *Joſephi-gallery* they met with a rough

rough hard rock, which determined the proprietors to drop it entirely. Every enquiry was unſucceſsful, ſince the mine-officers in theſe parts do not know any rocks but limeſtone and ſlate, and ſince accuſtomed to ſearch after and to find their ores between theſe rocks, they neglect to obſerve any other ſort. They have this fault in common with the mine-officers in the imperial ſtates in general.

Aſk them the nature of their mountains? and I am ſure they will give you ſo indifferent a deſcription, that you cannot make any thing of it, but that they never troubled their heads with ſuch obſervations. However, the ſureſt rules of a rational working of mines entirely depend on this neglected ſcience of the mountains, their ſtrata and their varieties.

I might alledge to you many examples of the ill conſequences of this neglect. I examined a mine in *Hungary*, which in former times had yielded a rich overplus from a pyritical vein, containing gold, and croſſing an argillaceous rock adjacent to granite. This vein was cut off by the granite, and as the ſame ſeems to have happened to a great depth the ancients gave it up. Of late they reſolved to take it up again. They followed the line of the compaſs in which the vein was known to run, and drove a long drift through the granite to meet again with the loſt vein; but

without any ſucceſs. The ſame would happen if they ſhould ſearch after it in the direction of its dipping; and all theſe pains and expences would have been ſaved if previouſly they had conſulted and conſidered the nature of the rocks. After this occaſional digreſſion I return to *Dognazka*. Beſides the before mentioned mines in *John's mountains*, there are ſeveral lead and copper fiſſures working in the *Wolf gang Dilfa* and *Morawiz* mountains; ſuch as *Mary victory*, *Chriſtoph*, *Traugot*, *Pancratius*, *New Gluckauf*, *Eraſmus* in the former; *Rochus*, *Fabianus* and *Thereſia* in the *Dilfa* mountains; and *Francifcus*, *Peter* and *Paul*, *Johanna*, *John Baptiſt*, *Trinity*, *Maria Litchtmaſs Paul* and *Simon Judas* in the *Morawiz* mountains.

Simon Judas is perhaps the moſt conſiderable copper mine ever diſcovered in Europe. After many inſignificant ſearches on the ſurface, a company of adventurers united in the year 1740, and in hopes of ſome ſilver ores, purſuing the upper gallery in a dead fiſſure, drove many drifts in the field; but the adventurers gave it up, and a ſingle remaining tenant, after being ruined, and having attempted a drift to the eaſt, diſcovered a rich copper fiſſure, on which at laſt they ſunk a ſhaft. The copper fiſſures croſſing and uniting here from every ſide form a ſtockwork, as they call it here, though it be different from the ſtockworks after the *Saxonian* principles, which are entirely independant

of the reſt of the mountain, and are ſaid never to have any hanging or hading ſide. An unhappy avarice prevailed then on the aſſociates, to encourage the finding of copper by prizes. The barmaſter was allowed five, and the furnace maſter three groſhes per hundred weight. This cauſed the barmaſters to work as farmers, and to conſider only their preſent advantage, without any regard what was to become of the mine in future times. Accordingly immenſe quantities were taken from this ſtock of rich ores, and tremendous caverns produced, which, unſupported, threatened inevitable ruin. But Count *Gotlieb Stampher*, at *Shemniz*, was at laſt commiſſioned to examine and to prevent this bad practice; and Mr. *Delius*, then barmaſter at *Dognazka*, ordained, that from the bottom of the ſtock upwards to the ninth level or gallery, the whole cavern ſhould be filled up with deaf rocks, except ſome ſmall doors and pits, left open for procuring the ore remaining in the depth. By this means the danger was prevented, or rather leſſened. This remarkable work I examined yeſterday. The rocks which ſurround t are Saxum metalliferum mixed with ſome lime. The gallery at the ninth level has been driven through it. The ſtock itſelf, at leaſt that part which is above this ninth level, has a hanging ſide of a ſcaly white limeſtone, and a hading of ſlate; but the whole ſtock, or rather all theſe united veins, are incumbent on gneiſs.

This gneiſs-ground has been explored for copper fiſſures by ſhafts and drifts; but finding that there was no chance of ſucceſs, the inferior part of the ſtock has been filled up, as I told you before, and this hindered me to ſee whether it does not conſiſt of Saxum metalliferum, and whether this variety of rock has not produced the irregular dipping of the vein, which at preſent is aſcribed to the large *Franciſci* vein croſſing in from the hanging ſide. At my entrance in the ſtockwork, I was greatly ſurprized by a magnificent view, which however, at ſecond thought, I found equally tremendous. The whole and wide cavity of the mine was illumined with a vaſt number of tapers, and the workmen ſtood or appeared hanging on the projecting ſtripes, or ſoles of rich various coloured copper-ore. The form of this ſtockwork is oval; its uppermoſt or firſt level has a breadth of three or four fathom; but it increaſes ſo much, that on the ninth level it has twenty-ſix fathom length and twenty fathom width. From this level it decreaſes in the ſame proportion towards the under part. I have told you already that this copper ſtock, or copper belly, is meerly produced by the coincidence of ſeveral veins, on which account it cannot be compared to other ſtockworks, as that for example at *Geier* in *Saxony*; but it has likewiſe a viſible run from eaſt to weſt, and a dipping, which from the firſt level to the ninth goes from ſouth

ſouth to north, and thence to the ſixteenth level, in an oppoſite direction, that is to ſay, from north to ſouth. The depth of the whole ſtock is forty fathom, and the *Joſeph-Shaft* is ſunk into it. The rubbiſh and ores are drawn out by horſes. So are the waters, which from the deepeſt ſole are pumped up to the ninth level, where they are carried of by a gallery. The annual dividend of this work is at preſent greatly decreaſing, ſo are the ores; and probably in ten or twelve years time the works will be at an end, ſince the many croſſing veins, by their oppoſite directions, ſtrike dead the rich fiſſures, concentrated in this ſpot of ground. The ſearching drifts on thoſe croſs veins give no hopes. Nevertheleſs they get ſtill every month 7 tons and a half of copper. The ores are lying in ſo cloſe a maſs together, that ſcarce any deaf rock is to be ſeen or dug out. For this reaſon the ſupports of the roof, and the ſtairs to the firſt, ſecond, third and ninth level, which are ſtill ſound, are cut in the fineſt variegated copper pyrites. The gang or vein rocks, which now and then offer, are a fine white and ſcaly limeſtone, calcareous ſpar, white achate with red and black ſpots, and yellow or black granulated garnet. (*Granatus figurae incertae particulis granulatis. Cronſtedt.* §. 69.) It is remarkable that, about an hundred fathom diſtant from the hading ſide of this ſtockwork, the *Paul*'s lead mine, and in about a ſimilar diſtance

from its hanging ſide, an iron mine is working. The ore of the latter is ſent to *Bogſham*. As probably ſome fiſſures of theſe veins are croſſing over to the adjacent ſtockwork, there occurs not only in the hading ſide of *Simon Judas* leadglance in copper ore, and yellow cryſtallized garnets, which in *Paul's* lead mine are extremely frequent in and next to its lead ores, but in the hanging ſide the ores are ſtriped and penetrated with ferruginous ocher. *Mary Victory*'s mine in the *wolfgang* mountains has been but of late begun working. It is in metallic rock, *Saxum metalliferum*, which the miners hereabout call ſandſtone. The vein or gangrock is a fine diſſolved white mica or glimmer, mixed with ſtone, and blended with copper pyrites. There is hope of good ſucceſs. In *John Baptiſts* mine, in the *Moraviza* mountains, breaks white alabaſter, girt with limeſtone and ſlate, and containing copper pyrites. The vitriolic acid of the pyrites might perhaps have changed the former alcaline gangrock into a gypſous ſubſtance. The *Iſidore* mine has been dropt ſome years ago, for not anſwering the expectation. It ſeemed to me however very remarkable, as being for a long way covered with a browniſh-yellow aſbeſtus, containing ironglimmer and black iron garnets. This aſbeſtus introduces itſelf into the copper fiſſure, and is the matrix of the copper pyrites. I made at *Dognazka* a large collection of

of ſcarce ores; and among the before deſcribed ſpecies I got the following ſamples:

Native lamellated gold in a brown iron clay from *Fabianus*. In this mine it is often found in lumps included in the copper vein.

Native copper from the ſame place, in large heavy lumps, which might be conſidered as ſmelted, if the red copper glaſs cryſtals, that ſurround them on every ſide, did not prove it to be produced by nature.

Native copper in brown iron ocher from *Simon* and *Judas* ſtockwork.

Grey cryſtallized copper glaſs ore. The cryſtals polyedrous ſticking on quarz, from the ſame place

Grey variegated copper pyrites from *Simon Judas*, called copper glaſs, on account of its content of ſixty to ſeventy pounds of copper, gloſſy on the fractures; differing from other copper pyrites by its red and blue colours not being ſuperficial but penetrating its whole ſubſtance.

Red cryſtallized copper glaſs.. The cryſtals oblong priſms, truncated on both ends. From *Paul*'s mine. Scarce; found in brown copper ocher.

Red copper mulm (tile ore) girt with a coat of verdegreaſe, which ſeems to be produced by an acid ſolution of the copper mulm. From *Mary Lichtmaſs* at *Dognazka*.

Grey copper-pyrites) *Cronſtedt.* §. 198.) cryſtallifed. The cryſtals have ten faces. From *Simon Judas.*

Grey and yellow mixed ſcaly copper pyrites; greatly reſſembling our ſcaly cobalt (ſherben-cobolt) however different on account of its yellow colour, from the ſame place.

Yellow and black undeterminate garnets, in large pieces, from *Paul*'s mine. They call them yellow or black hornſtone.

Yellow garnets of eighteen and thirty ſix points; often of the bigneſs of a pigeon egg. The miners call them yellow blend. From the ſame place.

LETTER.

LETTER. X.

Lugos, July 7th, 1770

FOR this letter you are indebted to the neglect of the poſtmaſter. I ordered the horſes at four in the morning; but he cannot procure me any before ten. For ſome hours I have been in this market town, viſiting ſome of my acquaintances, who commonly in this ſeaſon flock hither to a healthier climate, from the raging fevers at *Temeſwar*. I owe you ſtill a remark on the ſmelting in the *Bannat*; and here you have it: The ſmelting and refining of the copper at *Oravitza* is nearly the ſame which you have ſeen in the *Lower Hungarian* works, and is done in four different ſmelting places, called the *Franciſcus Mercy*, *Thereſia*, and *Saiger-hutte*. Great care is taken in rejecting the refractory ores.

Two tons of ore, twenty-four of pyrites and twelve carts of copper-ſlags are commonly put together in the firſt ſmelting. If the ores be remarkably ſulphurous the quantity of pyrites is leſſened; ſo the quantity of ſlags if they be mild. In twenty four hours time the buſineſs is done. The whole

gives

gives about three or four hundred weight of copper.

Seven tons and half of *raw-ſtone (Rohſtein)* produced by the firſt operation, make a roaſt.

The *black copper*, procured by roaſting, is refined on a ſmaller hearth, and in ſmaller quantities of about four or five hundreds.

All expences caſt up, a hundred weight coſts the proprietors from nine to eleven florins.

The parting furnaces *(Sayger-hutte)* are dropt at preſent, ſince the proprietors of the mines have found that their copper ores, containing ſilver, can be with leſs expence carried to and parted at *Thajola* in *Lower-Hungary*. The whole annual produce of *Oravitza* is about one hundred and fifty of copper.

Saſka has four furnaces, called *Charles*, *Joſeph*, *Maximilian*, and *Radimer-Hutte*. *Moldova* has but one. The proceſs in both places is the ſame as at *Oravitza*; but the vicinity of large foreſts makes it leſs expenſive; and the great plenty of copper mulm found at *Saſka* makes it there very eaſy. The *Saſka* and *Moldova* ſmelters boaſt of their ſmelting the ore with an increaſe of copper, its common aſſays giving only three or four pounds. This for a long while ſeemed a riddle to me; but I fancy with ſome reaſon,

ſon, that this additional produce is owing to their additional pyrites.

I have told you already that *Moldova* produces the toughest and most malleable copper. This ſeems owing rather to the ſulphurous nature of the ore, than to any particular advantage in the ſmelting.

Moldova gives per year about 50 tons, and *Saſka* about 150 or 200 tons of copper.

The *Dognazka* ores being greatly ſulphurous, their ſmelting and refining is leſs expenſive than at *Oravitza*, though the proceſs be entirely the ſame. There are three ſmelting places, with ten furnaces. The ores, ſmelted promiſcuouſly, and in common as at *Oravitza*, yield every year about 200 tons of copper. Theſe ores, containing leſs than nine ounces of ſilver, cannot be parted in our inland furnaces; * for this reaſon the proprietors have tried many experiments of other more ſucceſsful proceedings. Even at preſent the ſurveyor, Mr. *Fluk*, has propoſed a plan to precipitate the ſilver in the ſmelted

* This does not give any credit to the ſkill of the *Hungarian* ſmelters. The copper and lead ores of the famous *Ramelſberg* near *Goſlar* in the *Lower Hartz*, do contain but about one ounce of ſilver; and are beſides greatly refractory. However, they are with great advantage parted in the furnaces belonging to theſe mines.

copper,

copper, and by this means to ſave it. It would prove a great advantage to the proprietors. Mr. *Delius* has likewiſe propoſed and adviſed ſome alterations in the ſmelting, to deprive the *Dognazka* copper of the brittleneſs, which the copper-ſmiths complain of.

Some days ago Baron *Hegengarthen* received an account of the goldwaſhings in the *Almaſh*, and orders of the court to examine them. Counſellor *Koczian* is author of this account, and I will ſend it to you as ſoon I ſhall hear of the reſult of their examination

The evening before I ſet out from *Oravitza* we had a terrible thunder ſtorm. I happened to ſtand at the door, and to ſee under a violent lightning a flame riſing behind an oppoſite houſe, which keeping itſelf ſome time at its top ruſhed at laſt down on its foreſide, and then returned to the place whence it firſt aroſe. This phænomenon was repeated ſeveral times. We examined the place whence this electrical evaporation came from, and found that pyriticous fiſſures lay hid under the vegetable mould.

My journey from *Dognazka* to *Bogſham*, and thence to *Lugos*, is one of the moſt ſingular I ever made in my life. The danger of the roads cauſed Baron *Hegengarthen*, whoſe humanity you know, and whoſe kindneſs I never can praiſe too much,

to

to ſend orders for my ſafety wherever I had to paſs. Accordingly I found in every village forty or fifty *Wallachians*, armed with firelocks, who under the conduct of their chiefs eſcorted me to the next, and in rough or ſtony roads did bear my coach rather than ſupport it with their ſhoulders. The ſame day there was a general chace in the country to ſurround the foreſts and to ſearch after the robbers. This is done once every year, but commonly without any ſucceſs, ſince the requiſite orders cannot be kept a ſecret from the robbers, who for that reaſon ſtay quietly at home that day, or even dare, in compliance to the orders, to follow the general chace. *Bogſham*, where I dined, is but four hours journey from *Dognazka*. This place is ſituated in a fine valley, ſurrounded with clay ſlate and limeſtone hills, ſuperincumbent on our metallic rock (*Saxum metalliferum.*) The river *Berſova* runs through it, but the adjacent fens and ſwamps make its ſituation very unwholeſome. As *Servia* continued under the imperial juriſdiction, this place had many fine buildings and iron hammers; but now the iron trade is ſtopt. Nevertheleſs there are ſtill ſome iron hammers, and furnaces; and vaſt quantities of bullets and ſhells are caſt here for the imperial artillery. The iron ore comes from *Dognazka*. It is either red ore, *ochra ferri indurata rubra*; or black, *ferrum refractorium tritura atra textura chalybea*; and

and gives a good iron. Near *Bogſham* is a calcareous hill at a place called *Valga baja*, which contains immenſe quantities of broken oyſter ſhells and mytulites. From *Bogſham* to *Lugos* is a continual ridge of granite hills, below ſhivery micaceous clay. From *Lugos* they run to the eaſt towards the high mountains, which ſeparate *Tranſylvania* from the *Turkiſh* dominions. The calcareous hills about *Lugos* produce good wine; and I taſte it at preſent to your health

APPEN-

APPENDIX I.

FROM

MR. CHRISTOPH. TRAVGOTTS DELIUS,

Aſſeſſor in the Direction of the Mines in the Bannat:

A Propoſal to ſoften the Copper, preſented to the Imperial and Royal Chamber Court at Vienna, *July* 16, 1768.

THE copper ores, whether mineralized with ſulphur or arſenic, or with both together, contain, beſides the copper and the unmetallic earth, a part of iron; and they are diſtinguiſhed only by its greater or ſmaller proportion. The yellow pyriticous ores for example, the rainbow coloured, the fallow, the copper and the glaſs ores, and in general thoſe that are remarkably mineralized with ſulphur, contain more iron than the green and blue ores; but the copper ochres and liver ores contain more of it than any other ſpecies. This iron mixture, if in the ſmelting and refining it be not entirely removed, is the proper and real cauſe of the brittleneſs of copper; and though it be likewiſe produced by arſenic, this however happens

pens only if this half metal be united with iron, ſince by itſelf, and unconnected with iron, it is too volatile to reſiſt the intenſe and repeated heat of the copper preparation, if the roaſtings and ſmeltings be properly directed. Therefore the great principle to get a fine, malleable and ſoft copper conſiſts in its careful ſeparation from the iron; and the uſual practices are chiefly aimed at it, though by the following reaſons they fall more or leſs ſhort of their intention.

It is a known fact, that nothing deſtroys iron ſo faſt and efficaciouſly as ſulphur. Though commonly the copper ores contain a good deal of ſulphur in their mixture, it is inſufficient by itſelf to deſtroy the admixed iron. Therefore a certain quantity of ſulphur pyrites is added to every firſt ſmelting of copper ore, to get its ſulphur mixed with the iron, to have it by this ſulphur in the enſuing roaſting of the lech or raw ſtone calcined as in a cementation; and laſtly, to have the remaining ſulphur and iron ſcorified either in the ſmelting of the black copper, or in its final refining. This method of ſmelting, invented by our anceſtors, is in the main ſo well adapted to nature, that with all our refinements we are at loſs to invent a ſimilar or a better. It would certainly and perfectly anſwer all its ends, if there was not a circumſtance which cauſes difficulties, and is proved by metallurgic chemiſtry; and that is, that all ſulphur-pyrites contain a good deal of iron.

iron. Accordingly what is procured by one ſide is in a certain reſpect loſt again on another. Its ſulphur may very well be ſuppoſed to deſtroy the iron particles of the copper ores; but as it contains a good deal of iron in its own mixture, its ſulphur is inſufficient entirely to deſtroy the iron in the compound maſs, a part of which unites unaffected by it with the *lech* or *rawſtone*. In the enſuing roaſting the ſulphur, which remained in the rawſtone, together with a part of the iron, is deſtroyed by cementation; the former evaporating, and the latter changing into droſs, which in the following black copper ſmelting is taken off with the ſlags. On this account a part of iron remains in the black copper, which in the laſt refining cannot be entirely deſtroyed, as then ſcarce any ſulphur is remaining. Hence it comes to paſs, that provided there be no want of good intelligent ſmelters, thoſe places produce the beſt copper, where the ores contain but a ſmall quantity of arſenic and iron, and where they have plenty of good ſulphurous pyrites. If any pyrites was to be found entirely deſtitute of iron, it would undoubtedly produce the moſt excellent and ductile copper. But as that is not to be expected, and nature has not favoured our wiſhes, we are to look about us for other means to ſoften the copper; for which reaſon, and the encouragements granted by her Imperial and Royal Apoſtolic Majeſty,

I venture to propoſe ſome of my ideas, eſtabliſhed on many aſſays and experiments. However, before I come to my manner of refining the copper, I ſhall lay down ſome rules, which are highly ſubſervient to the purpoſe, and ſhould never be neglected by thoſe who are at the head of any great metallurgical works.

Primo. As I have ſhown already that pyrites, containing much ſulphur and a ſmaller quantity of iron, proves an advantage in the firſt or raw ſmelting, care is to be taken that ſuch pyrites, and not indiſcriminately any other, be choſen for the raw-work. No pyrites is to be made uſe of which is both arſenical and ſulphurous, ſince arſenic unites with the iron, and cauſes a great brittleneſs. For that reaſon the furnace inſpectors ought to examine their pyrites and their conſtituent parts, which commonly is neglected; ſince for the moſt part being unſkilled in the operations of metallurgic chemiſtry, they are unable to make ſuch analyſes. However they aſſay them with proper fluors for lech and ſtone. But the produced lech or ſtone-grain being a compound of ſulphur and iron, it is impoſſible to know by this uſeleſs aſſay how much ſulphur and how much iron is contained in the pyrites, and whether any arſenic is united to them. Sublimations in cloſed veſſels are preferable in every reſpect; and ſmelters and aſſayers ought to chuſe this method, ſince in the aſſays

assays of every sort of ores and minerals it certainly is more instructive and precise than the common empirical assaying. If by these means good pyrites be procured, proper care ought to be taken of the proportion, in which it is to be added to the first smelting. This is to be determined by the quality of the ore; if irony and refractory the addition of pyrites ought to be in a larger quantity.

But many faults are committed on this account; since many furnace inspectors, by a misapplied œconomy and to save some pyrites, or to have the rawstone rich, and to save the trouble and expence of roasting, grudge the addition of pyrites, and by that spoil the nature of the copper. There is never any real advantage in the riches of rawstone, since it impoverishes the mass of sulphur, which in the ensuing roasting is insufficient to destroy the greater proportion of iron. A good lech or rawstone should, to produce ductile or good copper, never contain above seventeen or eighteen pounds of copper in an hundred weight.

Secundo. If a copper mine produce pyritical and sulphurous copper ore, which, without any addition of other unsulphurous ores, are smelted with sulphur-pyrites as usual at *Smölniz*, it is greatly productive of ductile copper to have both ores and pyrites gently roasted before the first smelting. The reason is as follows: Sulphur

does not deſtroy the iron, by its combuſtible matter; ſince conſiſting of vitriolic acid and phlogiſton, the latter evaporates by a gentle roaſting. But the vitriolic acid penetrates into the iron, diſſolves it into a crocus and deſtroys it, which cauſes it in the enſuing ſmelting to go eaſily off with the ſlags, and to leave the copper regulus or the rawſtone in a more depurated ſtate. Though this be an undoubted principle of rational metallurgy, I fear it will be objected to by ſome ſmelters, who know only ancient practices. Would they pleaſe fairly to try ſome experiments they might be convinced of its utility. However, it is to be obſerved *firſt*, that this rule is not general, becauſe, if refractory or unſulphurous ores are to be ſmelted together with the more ſulphurous ones, the roaſting is impracticable, ſince the vitriolic acid and the ſulphur of the latter, requiſite to the fuſion of the former, might be inconſiderately deſtroyed by it. *Secondly*, I have ſaid for very good reaſons, that the roaſting ought to be gentle. A violent roaſting might ſmelt the ores and unite the ſulphur to the iron and to the copper; and it is a known fact, that ſulphur, deſtroying iron in a gentle cementation, by a ſtrong fire, is brought into fuſion with it. Beſides an intenſer roaſting would deſtroy too much ſulphur, which, after the raw ſmelting, is likewiſe intended to ſcorify the deaf ſubſtances of the ores.

Thirdly.

Thirdly. On theſe principles there might be laid down many improvements of the common roaſting of lech or rawſtone. Any roaſting intended to be uſeful ought to be gentle. The object of roaſting rawſtone is partly the evaporating of the combuſtile ſulphur and of the volatile arſenic, ſo as to bring the maſs of ore cloſer together, and to facilitate its ſubſequent fuſion into black copper; and partly the producing of the ſulphurous acid and its calcining and deſtroying the iron of the rawſtone. This double object is better obtained by gentle than by violent fire. In a ſtrong fire the ores coagulate and ſmelt together; the arſenic uniting with iron is fixed, and both make with the fluid ſulphur and copper a compound maſs, which is hard to part again. To be convinced of it, melt iron, ſulphur and arſenic into a regulus, pulverize it and expoſe the powder to a gentle fire; you will find theſe minerals evaporated in a ſhort time, and the deſtroyed iron remaining in the crucible. But put the ſame in a ſmelting fire, you will find the whole for many hours in fuſion, without any remakable decay or deſtruction.

To obtain the ends of gentle roaſting the following rules are to be obſerved:

1. The roaſt ought never to be in open air, but to be included by walls and to be ſheltered, to ſhut out the irregular blowing of the wind and rain and

ſnow, as either producing by intenſe fire a partial coagulating and ſmelting of the maſs, or by interrupted fire an unequal and imperfect roaſting, which in either of theſe caſes puts a ſtop to the intended evaporation of noxious minerals, and the deſtruction of the iron.

2. The maſſes ought not to be too large. The common practice at preſent is to roaſt one hundred and eighty or about two hundred hundred weight of lech or rawſtone together; nay, ſome furnace inſpectors, to ſave a trifle of charcoals and wood, go ſtill above that quantity; but this grudging œconomy ſpoils the copper, ſince the greater the heap the greater the fire, which is produced by the greater quantity of ſulphur, and cauſes a ſmelting and coagulating in the maſs, whoſe obnoxious effects have been touched upon before. More and ſmaller maſſes, each of one hundred, or at moſt one hundred and twenty hundred weight, might be preferable; ſo it will prove equally conducive to ſpread the ore in thin layers over the alternate wood, and only to employ in the firſt fire as much fuel as might be requiſite to a gentle roaſting, which in the following fires is conſtantly to be kept gentle and equal.

3. In ſome caſes the double rawſmelting is to be conſidered as a great advantage to produce ductile copper. Innoxious to any ore, it might be ſuperfluous with ſome ſorts; but it is highly uſeful

uſeful and neceſſary for thoſe that are arſenical and irony, or refractory on account of brittle and deaf minerals or half metals. It is impoſſible by the firſt ſmelting to remove the greater part of theſe noxious minerals, and it is equally difficult in the ſubſequent roaſting and black ſmelting to deliver the metal from their influence. Therefore two or three gentle roaſtings of the lech or ſtone of the firſt rawſmelting, and its ſubſequent ſecond ſmelting with a proportionable quantity of pyrites into a *double lech*, are to be greatly commended, ſince the ſulphur of the pyrites unites in the ſecond ſmelting with the deſtroyed minerals, calcined by the preceding roaſtings, and carries them off in ſlags. This *double lech* is then to be brought to a regular roaſting, and afterwards ſmelted into black copper. But in this proceſs the rule of an equal gentle roaſting is more carefully to be obſerved than in any other; elſe the whole will run together, and the wild and deaf minerals ſo cloſely unite to the copper, that it will prove almoſt impoſſible to ſeparate them again.

As it is an acknowledged rule, that only *good black copper* produces *a good fine copper*, I do not dwell any longer in recommending the preceding general rules, and the careful roaſting, which is too much neglected. By what I have ſaid it clearly appears, that the fine copper will be brit-

tle and irony, in the ſame proportion as the previous works have been neglected. However, whatever care be taken there will ſtill remain ſome iron, even in the refined copper. The reaſon is this: A hundred weight of good black copper contains commonly about ninety pounds of fine copper, and about ten pounds of iron, or ſometimes arſenic united with iron. The trifling quantity of ſulphur ſtill exiſting in it deſtroys during the refining a part of this iron, and even the fire ſcorifies a part of it; but as generally the iron in the black copper is equal in weight if not ſuperior to its ſulphur; this little ſulphur is certainly unfit to ſcorify it entirely.

Therefore I have ſuppoſed, that during the refining ſomething might with great advantage be added to the copper, to purify and to ſoften it entirely.

Two mineral ſubſtances deſtroy and ſcorify iron, litharge and ſulphur.

The former is unfit for the refining on the *hearth* (*Gar-herd*) ſince the glowing coals which cover the copper might reduce it into lead, and this uniting with the copper cauſe it to be leadiſh; but in a *parting furnace*, where the copper is kept in fuſion by the flame, it might do, ſince wood flames do not reduce it, facilitating rather the calcination of lead, and leaving it floating as litharge on the ſurface of the copper. Being under

theſe

theſe circumſtances in a continual motion on the ſurface of the boiling fluid copper, it will attract the remaining iron particles, ſcorify with them, and leave the copper in its higheſt purity. The quantity of litharge is to be determined by the leſſer or greater quantity of black copper. Six or eight pounds per hundred weight might do.

Concerning the refining *on the hearth*, the beſt effect is to be expected from common officinal ſulphur. The iron has no greater enemy, and it does not affect any other metal as long as it has iron to work upon and to adhere to. Accordingly, as ſoon as the black copper is brought to ſmelting fuſion and boiling ſulphur in pieces ought to be put on its ſurface, and covered with coals to concentrate the boiling. This may be repeated two or three times; but the compound ſulphur and iron ſlags are carefully to be taken away, and no more ſulphur to be added, than what is requiſite to deſtroy the iron; elſe the ſuperfluous ſulphur uniting with the copper cauſes unneceſſary expences and lengthens the refining. For this reaſon the black copper is previouſly to be examined. In proportion to the iron contained in the black copper, three, four or five pounds of ſulphur will be ſufficient to its deſtruction, and to the copper's higheſt refining and ſoftening.

This ſulphur-refining will equally do in the parting furnace.

Theſe

Theſe propoſals are, for what I know, entirely new and never practiſed before; however, they are ſo adequate to the natural rules of metallurgy and ſo cheap, that I dare hope they will not only ſtand the trial of impartial intelligent ſmelters, but prove likewiſe highly conducive to the production of fine, ſoft and malleable copper.

POSTSCRIPT.

It has been demonſtrated before, that the copper will be leſs irony in the ſame proportion as the pyrites added in the firſt rawſmelting are deſtitute of iron. But as the pyrites are commonly to be uſed as they may be had, and generally any ſort of them contains a good deal of iron, the following proceſs is recommended as an improvement of the firſt rawſmelting.

At preſent the pyrites is added to the rawſmelting of the ores in its natural form; but it would be better to ſmelt it ſeparately, and to bring it previouſly into a ſulphurous regulus, ſince the greater part of its iron will be by ſuch a ſmelting brought off in droſs, and its lech or regulus conſiſt for the greater part of a pure ſulphurous maſs. This ſulphurous regulus I propoſe to mix with the copper ore in the firſt rawſmelting; and half the quantity of the uſual natural pyrites will be

be ſufficient to produce a leſs irony copper regulus, which according to my rules, and properly roaſted, will undoubtedly give a very malleable copper.

The objection, that this ſeparate and preparatory ſmelting of the pyrites will cauſe a conſiderable expence is of no great weight with me; ſince the pyrite regulus being a milder and eaſier fluor than the unprepared raw pyrites, the fire and time requiſite to prepare the pyrite regulus will for a great part be ſaved again in the eaſier and ſhorter rawſmelting.

APPEN-

APPENDIX II.

Obſervations on the Goldwaſhings in the Bannat,

BY COUNSELLOR KOCZIAN,

With the reſult of the enquiries made after them

BY MR. DEMBSHER.

AMONG the ſeveral natural advantages of the *Temeſwar Bannat* ſome of its rivers are known to yield gold-duſt. I could not neglect this object when lately I travelled in theſe parts.

The goldwaſhing in the Bannat is properly the buſineſs of the gipſies *(Zigeuner)* and left as it were to this poor people as an excluſive trade. This laid me under the neceſſity to apply to them for inſtruction.

The river *Nera* in *Almaſh* carries gold-duſt, and ſeemed to me the fitteſt for my purpoſe; accordingly I cauſed ſome gipſies, reputed to be very ſkilful, to make a waſhing near a village called *Boſhowiz*; and I ſaw with pleaſure, that with much dexterity in a few minutes time, they cleared in the trough the value of ſome groſhes

of

of gold; they ſhowed me likewiſe among their gold-duſt ſome pieces of a remakable bigneſs.

After having ſufficiently obſerved and examined their ſimple maniputations, which I ſhall ſpeak of more in the ſequel, I wanted to know the origin of this river gold.

A particular circumſtance favoured my curioſity. I ſaw that the gipſies waſhed it from the ſands not only taken in the river, but likewiſe from its borders, nay even from ſome pits in the adjacent ground. Theſe pits are commonly four foot and more deep, and yield richer ſands than the river itſelf. They told me likewiſe, that the river ſand grows richer in the ſame proportion as the waters are high; and that it is poorer in dry weather. Such it was in 1769, and conſequently they were forced to open the goldſand pits in the adjacent grounds.

I examined theſe pits and the country around the *Nera*, which has been delineated in the annexed plan.

The ſtrata on its borders are as follows: The firſt is common vegetable mould, nearly of one foot thickneſs; the ſecond loam, two feet; the third pebbles and calcareous earth, hard to be dug with pickaxes, one foot and a half; the fourth or the goldſand bed is three feet, conſiſting of a mixture of pebbles, rockſtones and fine irony ſand. This laſt ſtratum is the ſame which the

gipſies

gipſies, at thirty fathoms diſtance from the river, dig out for waſhing. According to what I could ſee in the pits this bed has a flate bottom; and ſomewhat lower down the river a large coal-ſtratum baſſets out. I might therefore ſay with ſome probability, that after the flate follows clay, then marle, and afterwards the coal bed.

From all this follows, 1. that the gold-duſt is not generated by the water, but brought in the river beds by accident, becauſe in the former caſe it ought to be found in conſtant and equal quantities, whether the water be high or low. 2. It ought to be had from ſuch beds which may be eaſily diſſolved by water; accordingly it is not owing to found veins, ſince rain water and torrents cannot poſſibly be ſuppoſed, in their ſhort and intermittent flowing, to carry off even that part of gold which they commonly leave behind; and beſides they would have long ſince diſcovered the veins in the many countries where gold is waſhing, and where no ſuch veins have been found out. 3. Therefore the gold-duſt is probably owing only to clay and earth beds, diſſolved and carried off by water.

The bed which the gipſies dig out is of ſuch a diſſoluble nature; it is gently dipping, and by what I could ſee aſcending or riſing from the weſt to the eaſt. Being in this hanging or gently dipping ſituation, it may poſſibly be laid bare in ſeveral

veral parts of the river borders, and washed off by high water, which very well explains the greater success of the washings after heavy rains.

On my further journey in the Bannat I observed many marks of old washings, probably left by the *Romans*. They pursued likewise the gold impregnated beds, which in many places must be six fathoms above the river borders. Near *Werscherova*, *Polvaschniza*, *Purlava*, *Tumul* in the *Karansebez*, and in the valley *Walle-mare*, towards the limits of *Transsylvania*, from *Obava-Pistra* till *Marga*, it is plain that they dug for gold in such elevations, which never could be reached by the river water. In *Transsylvania*, near *Olah Pian*, at the foot of the *Rudel* mountain, many old gold-pits are found in a dry country, which is entirely destitute of brooks and rivulets.

This clearly shows that the gold impregnated beds are not tobe considered as river sediments deposited on the borders. § If they were successively accumulated and washed off from the adjacent hills, there is no reason why the gold should be

§ This may be and certainly ought to be granted, in respect to the present visible brooks and rivulets; but may be with equal justice denied in respect to those of former times, since the surface of the earth has undergone so many successive revolutions, and ancient seas, lakes and rivers are every where traced in the present continent by their former effects. (Transl.)

only

only contained in a ſingle bed, and never to be found in the upper vegetable mould?

The ſolid compact ſtratum of dragged pebbles and rocks, which is ſuperincumbent on the gold bed, is a further argument for its not having been produced ſucceſſively; ſince no reaſon appears why the gold-duſt might have been carried and depoſited under this compact ſtratum. ||

Therefore we have the greateſt reaſon to believe, that the gold impregnated bed is owing to the deluge, and that accordingly it is wide, ſtretching through conſiderable tracts of land. * In this ſuppoſition remains but a ſingle queſtion: whether this bed be throughout impregnated with gold? Though this might be affirmed for very good reaſons, I will however, to corroborate it, take notice that the *Romans*, beginning their waſhings near the river, continued them a hundred fathoms length in the adjacent lands, and as long as they could reach and eaſily lay open the gold

|| Theſe two inductions are extremely precarious. Might not ſucceſſive revolutions, whatever they were, produce different ſtrata of a different nature? (Tranſl.)

* The latter is fact; and the diluvian ſuppoſition a bad conſequence drawn from precarious inductions as well as from too narrow principles. (Tranſl.)

bed

bed without driving galleries, which ſeem to have been unknown to them. ‡

By ſimilar circumſtances the gipſies have no chance to make any greater progreſs, being confined to the gold which is carried by the rivers, or contained in the leſs incumbered and buried gold-bed near their borders.

However, the object being of importance, and deſerving nearer examination, I ſhould adviſe to drive a gallery in the gold impregnated bed, and to examine how far it runs into the field, and whether it conſtantly keeps the gold impregnated quality? If it ſhould be found to extend a conſiderable way in the mountains, and to continue gold impregnated, it would be worth while to have large waſhings on regular hearths.

The preſent manipulation of the gipſies is as follows: They uſe a board of lime tree one fathom length, and one inch and a half thick. At the upper end is a ſmall trough, and a croſs the board are ten or twelve ſmall cuts or furrows. This board they raiſe at one end, under an angle of nearly forty-five degrees. The ſand is put in the trough at the upper end, and

‡ Mr. Koczian is very unhappy in ſuppoſitions. Had he never heard of the *cuniculi* of the ancients? What are they but galleries?

thence by plenty of water waſhed down the ſloping of the board. This cauſes the lighter ſands to be waſhed off, and the heavier ones to remain in the furrows and on the ſurface of the board, whence they are ſcraped or bruſhed off, to be ſeparated from the gold by the operation of the common trough. Their whole proceeding is ſo extremely careleſs, that a good deal of gold is loſt by it; and what is ſtill more to be pitied they get but the pure gold-duſt, that which is ſtill ſticking to the ſands and ſtones being thrown away, as I am convinced by the microſcope, nay even by ſimple ocular inſpection.

This circumſtance deſerves nearer examination: whether theſe ſands and ſtones be rich enough to bear the expence of pounding? A ſmall trial might be ſufficient. If they ſhould appear to bear it, regular mining and pounding would be adviſeable.

I cannot conclude without adding a particular obſervation, which I had an opportunity to make near the many old and new gold-waſhing places in the Bannat, and which I conſider worth attention. I found that the higher promontories on the gold impregnated rivers do not conſiſt of ſolid rocks, but of ſoft earth-beds, which give good indications of coals and alum ores. Near *Boſhowiz* on the *Nera*, which is known by its gold-

waſhings

waſhings, I ſaw a large coal bed baſſetting out at a ſmall diſtance from the gold ſand bed; and almoſt in every place, which I have ſpoken of before, the exterior appearance of the ground countenances the concluſion, that coal beds are below the gold impregnated ſtratum, and that theſe in a certain reſpect are to be conſidered as its ſole. They had perhaps ſome ſhare even in the generation of the gold; at leaſt, they have a great relation with gold, ſince it is not impoſſible to extract from them a hepar ſulphuris, which is the ſtrongeſt diſſolvent of gold.

However this be, it is fact that coals are to be found in every gold waſhing-ground. The *Danube* and *Ens* may ſtand an evidence, ſince on the borders of the *Danube* from *Vienna* to *Paſſau*, nay ſtill higher up, coal beds offer every where. Therefore I do not doubt, that the ſame gold impregnated ſtratum may be traced out on the borders of theſe rivers, and regularly worked to advantage.

According to theſe obſervations and accounts of Counſellor *Koczian*, and the orders which I had received, I proceeded to my enquiries in the following manner:

As ſoon as I arrived at *Boſhowiz* I enquired after the place, in which Baron *Koczian* had made his obſervations; and I found it as laid down in

plate to which this explanation is belonging.

A. *Meniſh*; a brook.

B. *Boſhowiz*; a village.

C. The ground, where Baron *Koczian* cauſed his waſhings. It riſes gently towards the mountains; and

D. a gallery of one fathom length was drove into it.

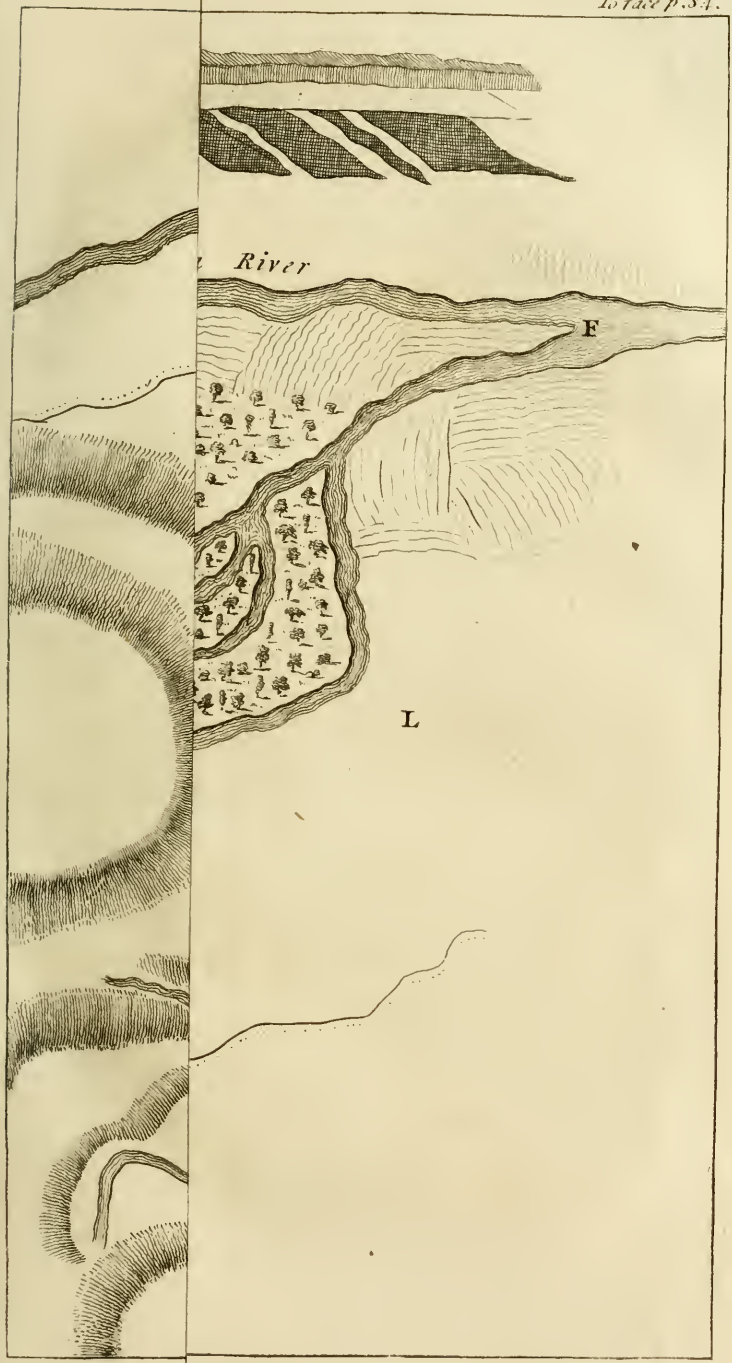
E. The coals in different beds.

F. Mouth of the *Meniſh*, where it runs into the *Nera*.

Near K and L the ground is very flat; and conſiſts, as appears in ſome higher borders, of different ſtratified earth and ſtone beds.

After a general ſurvey I cauſed the works at D to be cleared, to get acquainted with Baron *Koczian*'s gold impregnated ſtratum and its foundation. I found it agreeing with his deſcription, and conſiſting of a mixture of brown loam, pebbles, rocks, mica, garnets and iron ſand. But the under bed was no ſlate, conſiſting rather of a brown ſandſtone, extremely mouldering and friable in the pit, and hardening in the open air.

Acquainted with the object of my enquiries, I advanced 27 fathom nearer to the mountains, and orderd a ſhaft to be ſunk in G. In a depth of one fathom and a half I reached the gold impregnated ſtratum. A waſhing convinced me of its containing


River
F
L

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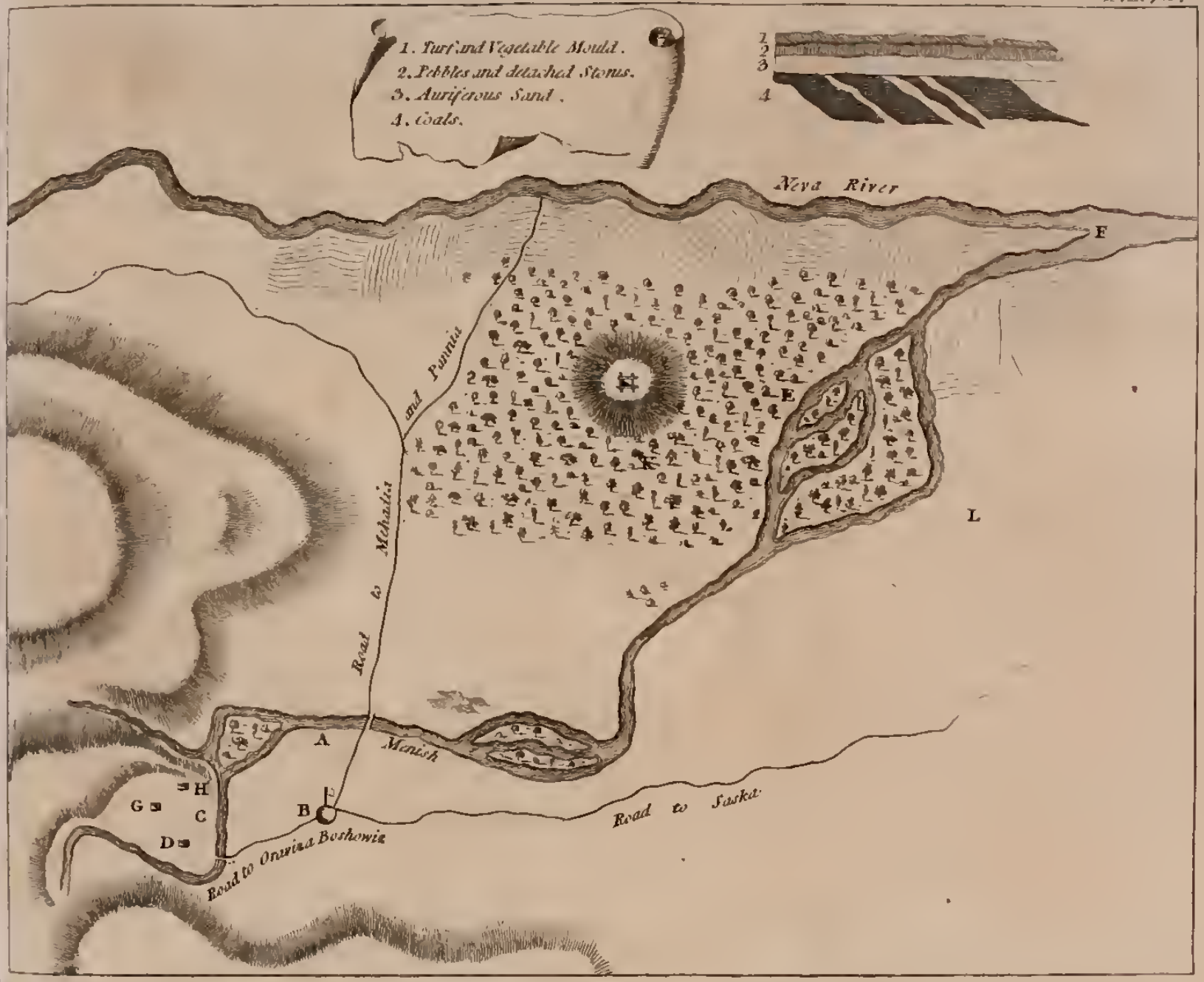
1. Turf and Vegetable Mould.
2. Pebbles and detached Stones.
3. Auriferous Sand.
4. Coals.
1
2
3
4
Neva River
F
E
L
Road to Mehadia and Pannia
A
Menish
B
H
G
C
D
Road to Oraviza Boshowiz
Road to Saska

containing gold; and I ordered thirty carts load to be laid aſide for a great waſhing on the hearth. I advanced then ſtill twenty eight fathom more, almoſt to the foot of the mountains; and to be convinced of the extenſiveneſs of this ſtratum, I cauſed a ſhaft to be ſunk in it, twenty-two fathom to the ſouth. Here I found the beds entirely different. The grey loam immediately under the turf was very tough, and a fathom thick. Then followed brown loam five foot, afterwards the compact pebble bed four $\frac{1}{2}$ foot, and then the gold impregnated ſtratum. After a little trial in the trough, I ordered as much to be laid aſide as might be full ſufficient for a waſhing at large. Then I proceeded to theſe waſhings on a hearth, exactly conſtructed as thoſe at *Shemniz*. The reſult was as follows:

Firſt proof. Thirty carts from the ſhaft G yielded two grains of gold.

Second proof. Thirty carts from the ſhaft H yielded ſcarce half a grain of gold.

The greateſt care was taken, and I was too well convinced, that ſuch profits could not bear the expences of mining, which, as here to be undertaken immediately under the turf, would require a good deal of timber, of which the whole adjacent country is entirely deſtitute.

Therefore I dropt my works in this place, and examined the bed which is gently riſing on the

coal ſtratum along the *Meniſh*, and in ſeveral places is three fathom above the water level. I conſtantly found ſome gold flakes in the trough; but in ſo ſmall quantities, that I ſaw no encouragement for a waſhing hearth, and I gave up every hope of mining. The common gold-waſhers having for the moſt part retired to *Banya*, *Ruderia* and *Telpoſhiz*; I followed them to theſe places to examine the ground and earth which they were waſhing there. At *Telpoſhiz* I found it as in the before deſcribed places; but at *Banya* and *Ruderia* I ſaw the gipſies ſeeking for gold in the gutters and furrows of the mountain-brooks.

So much for the hiſtory of my enquiries. I ſhall add ſome obſervations produced by them, and explanatory to thoſe of *Counſellor Koczian*.

1. As ſoon as a ſhaft or drift reaches the gold impregnated bed you reach water. This is ſo general that I have found it ſo in the ſhaft H and E, three fathoms above the water level of the *Meniſh*.

2. The gold waſhed hereabout is entirely native, free from any matrix. It appears in fine duſt. Tho' the exterior appearance of this mixed ſtratum convinced me, that it is not owing to gold veins and fiſſures, and that accordingly its rocks and ſtones cannot poſſibly contain any gold, I cauſed however for my fuller conviction the waſhed ſands and

and ſtones to be ſtampt and waſhed again. No gold appeared. I then had them roaſted by fire, but without any better ſucceſs.

3. The deeper this bed under ground the richer. It grows poorer in the ſame proportion in which it aſcends to the mountains; which in a certain manner is to be explained by the firſt obſervation.

4. This gold impregnated bed yields every where a pure black ſplendent ſand, which might be called perhaps native iron, ſince it is drawn by the loadſtone.* In the gutters and furrows at *Banya* and *Ruderia* but an inſignificant quantity of this iron ſand is found; they give a greater quantity of pyriticous ſand, which, together with the ores and gang-rocks, is a ſtrong preſumption for copper mines. The fine ſituation of theſe mountains, water, wood and timber being plenty, might give a zealous miner a mind to explore them.

It is very difficult to determine the origin of gold-duſt contained in this ſtratum. Though the diſcovered beds, the extenſive coal ſtratum, and now and then ſome petrifactions, be ſtrong evi-

* The tranſlator has verified this obſervation in the gold-waſhings on the *Eder* in *Heſſe*. He might perhaps give a natural reaſon for this iron ſand, which conſtantly is found concomitant with the gold-duſt.

dences of great inundations; there appears no ſufficient reaſon why the gold duſt ſhould be only mixed in the ſubſtance of a ſingle bed? As I am no friend of conjectures, I leave the explication of this phænomenon to men of greater genius, enabled by their extenſive knowledge and experience in Natural Philoſophy, to make diſcoveries beyond my capacity.

I am to anſwer here to an objection which ſeems to be a juſt one, and is, that notwithſtanding the poorneſs of theſe ſands, the value of ſome thouſand florins of gold is produced every year. Though this be fact, and a conſiderable ſum in itſelf, it is a very inconſiderable one in reſpect of the great number of people employed in the waſhings. There were for example in the year 1770, in the neighbourhood of *Uy Palanka*, *Orſowa* and *Caranſebez*, above 80 families of goldwaſhers, men, women and children, employed in that buſineſs; and nevertheleſs they have not made good above the value of ſix or ſeven hundred ducats. Hence it appears to me that theſe waſhings are no objects for miners, and leſs ſo for *Germans*. The gipſies go half naked; whole families live at the daily expence of a groat, nay cheaper. Satisfied with this petty allowance, and unconcerned at their nudity, they waſh gold in ſummer time, and during the winter they cut wooden troughs, ſpoons

ſpoons and the like, which they ramble about with ſelling and begging. A miner would ſcorn ſuch a life; and if you would keep them better, whence is to ariſe the profit of the ſovereign, which in the common way of the gipſies is ſomething, though it be inconſiderable?

Concerning their manipulation it ſeems to be at firſt ſight very rude and bungling; but it is very juſt in itſelf. Practice has given them an experience, deſtitute of which one might conſider their proceſs as very deficient. I am convinced of it by its following examination. When they had finiſhed a waſhing of fifteen or twenty troughs of ſand on their uſual board, which is ſeven foot in length, rifled with fifty or ſixty tranſverſe furrows, and erected under an angle of eighteen or twenty degrees, I cauſed the ſands, which remained in the furrows, to be divided into three parts. The greater part of gold ſtuck conſtantly in the ten or fifteen uppermoſt furrows; in the enſuing diviſion I ſcarce met with the eighth part of the former; and in the laſt fifteen or twenty furrows ſcarce two or three flakes of gold were to be found. I have likewiſe carefully examined the ſands, which they had waſhed already, and it was but very ſeldom that any mark of gold was left in them.

Such

Such was the reſult of my firſt journey, which, contrary to my expectation, produced a ſecond. Unluckily I had not clearly enough explained my third obſervation; and Baron *Hegengarthen* was hence inclined to believe, that the gold impregnated bed might prove richer in a greater depth. Therefore he propoſed to ſink in K a ſhaft of nine or ten fathoms depth, till a ſolid ſound and barren rock might be reached; and I was accordingly ordered to return with two able workmen in the *Almeſh*, and to try the experiment.

It was *June* 13th in 1771 when I did ſo. The point K is about three feet above the water level of the *Meniſh*, which having in E torn off a ſteep part of its borders, and by that accident laid open the coals and the other ſtrata, I could with certainty foretel that the ſole of the gold impregnated ſands would prove to be either the coal or the alternating marle beds. With the ſame probability I might have foretold the bigneſs of theſe ſtrata.

After $\frac{3}{4}$ fathom of vegetable mould I reached the firſt ſand and pebble bed and water, which increaſed, ariſing from the ſole, in the ſame proportion as we ſunk deeper. Two troughs of rubbiſh were had with five or ſix troughs of water. This circumſtance and the conſtant rains filled my unſheltered works with ſo much water, that by twelve hours labour I could not get but three foot depth. After one $\frac{1}{2}$ fathom I reached the gold

gold impregnated bed, which I very often examined on the trough, but conſtantly found ſo poor that a large mine trough contained often but a ſingle flake, and often nothing at all. At laſt we fell in with the coals, and having ſunk my work $\frac{1}{2}$ fathom in them to no purpoſe, and found that the beds were the ſame as thoſe by accident laid open in E. I gave up my works in this place, and examined rather theſe diſcovered ſtrata. The reſult was the ſame as that of my former enquiries.

My many ſmall waſhings did not encourage me to further experiments; and thus I dropt my repeated enquiries.

To prevent all further doubts I add an obſervation, which proves with nearly mathematical evidence that this ſide the *Meniſh* only coals and marle, and on the other ſide towards the mountains only ſlate and ſand ſtone will be found by digging deeper.

The gold impregnated ſtratum is conſtantly parallel to the turf and vegetable mould. It does not anſwer at all to the dipping of the lower ſtone beds. This appears clearly in E, where marle and coals, alternating with regularity, are never parted by earth beds but covered by the gold impregnated ſtratum, which is parallel to the turf. The ſection plate explains it to the eyes.

Here

Here the queſtion ariſes again: why this gold was produced in this ſtratum? I freely confeſs that I am at a loſs to anſwer it; but I cannot entirely abſtain from propoſing ſome conjectures, which perhaps may aſſiſt others to diſcover the ſecret.

The hypotheſis of thoſe, who explain the origin of coals by foreſts, buried and ſwallowed up by earthquakes, gains ſome credit by the exterior appearance of the *Alimaſh*, whoſe ſoil is every where interſected by hills and rivers, and is entirely deſtitute of wood. But the remarkable regularity in the alternating and parallel coal and marle beds does not agree with the idea of ſuch diſmal and violent deſtructions. The ſtructure of the uppermoſt looſe ſoil in theſe parts is more eaſily to be explained by inundations. It is a known fact that gold and iron are generated and produced in many flat countries, and that theſe metals are dug in many places beſides the common veins and fiſſures. The Dutch ſea ſand and the iron, which in different places is found concomitant with the gold duſt, are ſtrong evidences.§ Suppoſing this native gold to have been contained in the uppermoſt and looſer beds of the

§ Of what? That the gold or iron is generated in theſe beds? No; that they are commonly found together, and that having perhaps had a common origin, they have been waſhed and depoſited there by the ſame revolution or natural cauſe, whatever this be.) (Tranſl.

hills,

hills, it could be thence carried by inundations into lower grounds, and as inundations do not retreat but ſucceſſively, gold, iron, garnets and ſherl ought of courſe, and according to their ſpecific gravity, to have taken the loweſt place, and to be depoſited in thoſe flats, which as the loweſt have been interſected by the rivers.

This opinion agrees exactly with experience, and explains the reaſon why the gipſies get greater quantities of gold in high water that in dry weather. By heavy rains the borders of the rivers and brooks are worn away; nay, under ſuch circumſtances, the rivulets take often a quite different courſe. This faciliates the manipulation of the gipſies, becauſe the water diſſolving and carrying away the argillaceous particles, and leaving only the heavier ſands and the gold-duſt behind, they get by a ſingle trough of ſand as much gold as they might have waſhed from two or three troughs of the undiſſolved natural ſands.

But is this an explication of the orgin of this gold duſt? Certainly no. However, I have done what moſt naturaliſts do, I have advanced my opinion.

FRANCIS DEMBSHER.

LETTER

LETTER. XI.

Nagyag, July 12, 1770.

THE plains, which I reached near *Lugos*, continued half ways to *Dobra*, where I found an aſcending ground of argillaceous ſlate. Beyond *Dobra* I met again with our *Saxum metalliferum*. It continued to *Deva*. The roads are impaſſable. Between tremendous precipices and the river *Maros* on one ſide, and ſteep ſhaggy rocks on the other, I was dragged along, by eight oxen, added to the four horſes of my carriage. I arrived late in the night at *Deva*; but the ſafety of the roads made amends for their roughneſs. As ſoon as I came to the limits of *Tranſſylvania*, between *Dobra* and *Deva*, the two huzzars, which I had taken at *Lugos*, left me. *The Tranſſylvania Wallachians*, more humanized than thoſe in the Bannat, and the national frontier troops, together with the ſeverity of government againſt the robbers, contribute greatly to the ſafety of the country. It is but of late that three robbers have been at *Deva* impaled alive, for having committed ſome murders in the valley of *Hazeg*. This cruel and

and almoſt inhuman puniſhment, tho' uſed in *Slavonia* and the *Bannat*, has made ſuch an impreſſion on the inhabitants, that you may travel all the night with ſafety. The day after my arrival I viſited the copper-mines, which ſome years ago have been opened in a mountain to the weſt, three quarters of an hour's journey from *Deva*. The mountain conſiſts, at the foot, of a micaceous ſlate, covered with indurated marle rocks gently riſing. In theſe rocks are the fiſſures, which compoſe the copper ſtockwork at *Deva*. I deſire you would underſtand the word ſtockwork in the ſame ſenſe in which I explained it to you in my letter from *Dognazka*. However, there is a great difference between the ſtockworks of theſe two places. That at *Dognazka* conſiſts of large and very rich veins, converging and uniting in the ſame point: here it conſiſts of ſome fiſſures, uniting in a middle of ten fathom diameter, and mixed with dead rocks. They have purſued the run of the fiſſures, and ſunk in it a ſhaft of ſome fathoms depth, but without any ſucceſs either in the drift or depth. The vein (*gang-art*) is grey and looſe clay, now and then ſprinkled with quartz and ſpath, and containing various coloured and yellow copper-pyrites, which, if of the richeſt ſort, contain ſeventeen pounds of copper per hundred weight. A hundred weight of this copper contains one dram and two denarii of ſilver; and

and a mark of this ſilver two and a half denarii of gold. They cannot yet part either the ſilver or the gold, but they hope to do it by a future better ſmelting proceſs. The works in the mine are crippled. Wherever they found ſome ore they eagerly took it out, but left the work as ſoon asthey broke off. Hence aroſe ſo many holes, that the work reſembled rather thoſe of rabbits than of miners. They have not yet any ſmelting furnaces of their own; accordingly they ſend their ores to the ſilver furnaces at *Cſertes*.

In the afternoon I continued my way to *Nagyag*; and paſſed the other ſide of the *Maros* over high mountains, conſiſting of argillaceous rocks, mixed with mica and ſherl, and covered with argillaceous ſlate. After three hours ride I reached the village *Nagyag*. It has given its name to the town, which is one hour and a half's journey higher up in the hills, ſince it was the neareſt place when theſe gold-mines were diſcovered. I got here oxen to my carriage, becauſe the little *Hungarian* horſes, fit for plain countries, would not have anſwered theſe ſteep and high mountains. Towards night I arrived at *Sekeremb*, the proper name of the place commonly known under that of *Nagyag*. All around you ſee but foreſts, and in a valley ſome hundred houſes, ſtamp-mills *(Pochwerke)* bing-places, ſome large waſhing houſes

houſes, the council-houſe, and a church. The ſituation of this place, and the coldneſs of the weather, are unfit for huſbandry. The trade of the inhabitants is mining, and what belongs to it. The timbering of the mines, and the conſumption of the inhabitants, have cleared the foreſts ſo much that the timber for the mines is to be fetched from abroad floated on the *Maros*, which paſſes at the foot of the mountains. The noblemen, as lords of the ground, have no objection againſt this clearing of their foreſts; nay, they keep great herds of goats, to prevent their growing up again. Every nobleman keeps on his ground an inn, to ſell wine to the miners; and as the proprietors of the mines have engaged to diſcharge every month what their workmen may owe for wine, they have allowed for it the liberty to cut down in the foreſts whatever may be wanting for their mines and buildings.

The mountains are here entirely compoſed of our metallic rocks *(Saxum metalliferum)* which are covered with red argillaceous clay. The gold mine owes its diſcovery to accident.

A *Wallachian*, whoſe name was *Armenian John*, came to my father, then poſſeſſed of a rich ſilver mine at *Cſertes*, telling him, that as he conſtantly obſerved a flame iſſuing from and playing upon a fiſſure in the *Nagyag* foreſt, he was of opinion,

that rich ores muſt be hid under ground. My father was fortunately adventurous enough to liſten to this poor man's tale; and accordingly he drove a gallery in the ground, which the *Wallachian* had pointed out. The work went on ſome years without any ſucceſs, and my father reſolved to give it up. However, he made a laſt drift towards the fiſſure, and there he hit the rich black and lamellated gold ores, which firſt were looked upon as iron glimmer, but appeared what really they are as ſoon as aſſayed by fire. This happy accident cauſed my father to purſue the work to the utmoſt of his power; accordingly he diſtributed ſome ſhares among his friends, and had the works carried on with regularity. Soon after they diſcovered, beſides the *Ergezebaw* and *the white fiſſure*, three other fiſſures in the hading ſide, and a ſoaring fiſſure, which, moſtly parallel among themſelves, run in the direction of the valley from ſouth to north, dipping from weſt to eaſt. Theſe veins break off as ſoon as they reach the red ſlate which covers the valleys. The cauſe is obvious to you, and gives me good hopes, that whenever we ſhall chace theſe veins under the plane, on which the ſlate is ſuperincumbent, their run will be uninterrupted, ſince then no cauſe remains to intercept it.

In the oppoſite mountain we have diſcovered another fiſſure, called *John Nepomuck*. It has a conſtant

conſtant run to the ſame point north, in which probably all theſe veins will croſs and meet together.

The *John Nepomuck* vein has proved dead hitherto; however ſome ſmall neſts of ore have been hit already, and thoſe permit us to hope that it will prove richer in the aſcent of the mountain.

All theſe veins fall, and have been worked already to ſixty fathoms. It has been obſerved that thoſe, which towards the day or the turf were poor of ſilver and rich of gold, proved in the depth richer in ſilver and poorer in gold. The reverſe happens with thoſe that in the uppermoſt galleries yielded more ſilver and leſs gold.

Hitherto we have the advantage to run our ores by the galleries immediately to the bing places and ſtamp mills; and many years ago we begun (*erb ſtollen*) a draining gallery, which goes thirty fathoms depth under the preſent deepeſt ſole; nay, the nature of the ground allows us to think of a ſtill deeper gallery.

Our draining gallery is driven twelve fathoms in a bed of coarſe blunt pebbles mixed with ſome clay. Had it been more indurated it would have proved a fine Breccia. Then followed the red ſhivery clay, through which we have

forced our way 370 fathoms length. At preſent we work in ſandſtone, which grows harder as we go on, and gives good hopes that we ſhall reach the micaceous clay rock, and in it after a twenty fathoms drift the veins which croſs it.

The mouldering and foul quality of theſe different ſtrata has made our galleries expenſive and difficult.

To have at all events proper air conductors, and the requiſite room for the water channel, it was to be twelve foot high; and the ſides and roof were to be faſtened by oak door ſtocks, each a foot thick, and ſet cloſe together.

At the entrance of the gallery is a fan ventilator briſkly turning by a water-wheel in a cloſe room, whence wooden air-pipes and conductors convey the air at the bottom of the drift, and cauſe its requiſite circulation. The conductors *(wetterlotten)* conſiſt of four boards nailed together, and made tight in the joints by a cement of clay, tile-duſt, and tallow.

The workings are extremely regular. You would rejoice to ſee in many places four, nay even five platforms one above another continually yielding the richeſt ores; and it would certainly pleaſe you to find in many long drifts a roof of three or four foot large veins, which enſures to the proprietors rich dividends in future. The miners

miners are not allowed to work in the richer veins, but near them in the hanging ſide. Being nicely laid open that way, the ſole is wiped clean, cloths are ſpread upon it, and then the vein is taken down in the preſence of an officer. This they do at the end of any working day, or at the end of the week; and prevents not only ſpilling the ore among dead rocks but ſtealing it too.

By the *Daniel-ſhaft* the air is conducted into the deepeſt drifts, and the conveying of the ores in the galleries promoted.

The vein rocks conſiſt of red feld-ſpath and white ſaponaceous quartz, *(fetter quartz.)*

The richer ores are lamellous, ſplendent and black-grey; the lamellæ to be ſeparated from each other by a needle as thoſe of mica. They may be cut and bent.

Another rich ſpecies is finely woven into the ſubſtance of a bleak reddiſh feld-ſpath, reſembling the arſenical white ore from *Saxony*; but the fire proves it to be native ſilver, of a yellowiſh colour, on account of its mixture with gold.

Among the rich lamellous ores now and then occurs native ſilver mixed with gold.

Another rich ſpecies is called by the miners *cotton ore.* It conſiſts of little native ſilvery gold grains, in a black gold mulm, ſticking in an argillaceous matrix.

The other ores are likewiſe lamellated, but theſe lamellæ are but thinly ſprinkled into their ſubſtance. Some are entirely ſimilar to the ſcaly antimony and ſtain the fingers; others have a mixture of black lead lamellæ, which in cloſed veſſels are unaffected by fire, but under the mufle yield a ſmall corn of gold. In the midſt of this ore is very often found a radiated cryſtallized, but commonly a ſcaly and plumoſe grey antimony. *Antimonium plumoſum.* Red ſolid and cryſtallized arſenic, calx or orpiment, *calx arſenici, ſulphure mixta, rubra. Cronſtedt.* §. 241. n. 2. and fine grained cinnabar, are not uncommon. All theſe ſemi-metals brought to the couppelle leave ſigns, nay now and then ſmall grains of gold.

The richer ores are in wooden troughs carried to the ſeparating rooms, and there as nicely as poſſible ſeparated by officers under oath.

The richeſt ſpecies contains from ninety to 340 ounces of ſilver in a hundred weight; and each mark ſilver yields 200, to 210 denari gold, that is to ſay, twelve or thirteen ounces gold, or two parts gold and one part ſilver. The rock ſeparated from this ore, yields from fifteen to twenty ounces ſilver, and this from 160 to 170 denari gold per mark. The ſplittings and offal of this ore gives from twenty-five to thirty ounces ſilver, and this from 180 to 190 denarii gold.

The

The poorer ores are ſeparated in the waſh-works by iron ſieves. The greater pieces, which do not paſs the firſt ſieve, and thoſe that paſs the firſt and ſecond, are with hammers ſeparated from the dead rocks. Thoſe that paſs through the third and fourth are taken care of by the ſieve-maſters, and the duſt running through the remaining ſieves is waſhed on the common hearths. Theſe pyritous ores give two or three ounces ſilver, and this in the mark from ſeventy to 112 denarii gold. The ſeparated dead rocks of this ore are ſtampt, and with the common ores pulverized and waſhed. They yield one or one $\frac{1}{2}$ ounce of ſilver, and this per mark from 100 to 130 denari gold.

Whatever care you may take with ſtamping and waſhing the richeſt *Nagyag* ores, the beſt microſcope will not diſcover any flake of native gold. Counſellor *Scopoli* has chemically analyſed them in his *Anno* iv. *Hiſtorico-Naturali*. Profeſſor *Schreber* has given a tranſlation of his treatiſe in his collection of Finance Tracts. You have read them, and you will have perhaps an opportunity to examine the conſtituent parts of this unique gold-ore and Mr. *Scopolis'* Eſſays.

The ores are aſſayed every month, and accordingly ſeparated. The richer ones are pounded in iron mortars, ſprinkled with water, put into

ſacks, and together with the ſprinkled ores and waſhings carried by horſes over the mountains to the royal market at *Zalathna*, there to be aſſayed again by a royal aſſay-maſter, and to be paid accordingly to the proprietors.

The ores being watered they count at *Zalathna* three pound per hundred weight leſs. 2. They are charged ſmelting expences two florins a hundred weight. 3. And five per hundred fire loſs for the gold as well as for the ſilver. After theſe previous deductions the mark gold is payed to the proprietors 300 florins; and the mark ſilver nineteen florins thirty cruizers.

Victuals being extremely dear at *Nagyag*, as being carried there by men or horſes, the wages of the workmen are higher here than in many other places. Theſe and the common mining expences amount from ſix to 10,000 florins a month. Nevertheleſs a dividend of eight, ten, nay of 20,000 florins is diſtributed every month among the proprietors; ſo that in twenty years time above four millions of florins gold and ſilver have been produced in this ſingle place.

The proprietors have transferred upon her majeſty the Empreſs-queen the principality or the right of regulating the mining works. Her majeſty was poſſeſſed of ſixteen ſhares or actions. However, the proprietors are in caſes of importance

tance ſtill aſk'd their opinion. At preſent the works are under the direction of Mr. *Daniel Caſtellano*, her majeſties barmaſter. He is a miner of great experience, well acquainted with the nature of theſe mountains and ſucceſsful in his undertakings. He is the firſt in *Tranſſylvania* who built regular ſtamp-mills, and demonſtrated the advantage of the *Hungarian* ſtamp and waſhing-mills to thoſe that objected, by clearing in a ſingle day 300 weight ſtampt ores with ſeven ſtamp and waſh-mills built at *Nagyag*. The ſcarcity of water has very often in dry weather put a ſtop to them; therefore the proprietors are building at preſent a great water reſervoir in a higher ground, in order to ſupply the mills during dry weather.

LETTER

LETTER. XII.

Zalathna, July 15, 1770.

TRANSSYLVANIA deſerves to be examined by a naturaliſt endowed with a proper knowledge of minery. All the mountains of this beautiful country are full of ſigns of undiſcovered metals. Had I not had a time preſcribed, within which I was to return to *Shemniz*, I ſhould not have left ſo ſoon a country which is ſo intereſting to me, not only for being my native country but for being ſo rich in natural curioſities. It would certainly have made me rich amends for the pains of my enquiries.

The beſt and only reputable book on the Natural Hiſtory of *Tranſſylvania* is, *Samuel Koleſeri from Keres eer Auraria Romano Dacica. Printed at Hermanſtadt* 1717. The author, a learned phyſician, and afterwards inſpector-general of the *Tranſſylvanian* mines, has in this valuable book rather deſcribed the antiquity and floriſhing ſtate of the *Dacian* mines during the reign of *Trajan*, than their productions and natural circumſtances. With greater preſumption but leſs learning a certain jeſuit, *P. Fridwalzky*, attempted of late the

the Mineral Hiſtory of *Tranſſylvania*. His book has nothing to tempt you but the title, *Mineralogia Tranſſylvaniæ*. The materials of this dull performance are a variety of good and falſe accounts compiled from able but generally ignorant miners, which the good-natured prieſt was unable to make uſe of; falſe denominations of minerals ariſing from want of knowledge; half a dozen pious tales, fit for the entertainment of old goſſips; ſome authorities taken from *Koleſer*; abſurd inductions, conſequences and conjectures, ariſing from a thorough ignorance of chemical and mineralogical principles; and a good deal of civility and compliments to thoſe gentlemen, who entertained *P. Fridwalzky* with hoſpitality in his excurſions of mineralogical knight-errantry. Even the language, in which all theſe fine rareties are deſcribed, is ſuch bad Latin, and ſo overdone with flouriſhes, that one is in want of the ſenſe of *Œdipus* to gueſs that of *P. Fridwalzky*. I ſhall have perhaps an opportunity to converſe with this highly celebrated *Tranſſylvanian* mineralogiſt at *Clauſenburg*; then I will tell you who he is, and whether perhaps in future times we may expect ſome amends for the ſingular raree ſhow of his former performance. The mineral hiſtory of my noble country forces me often to a deſire to make here a ſtay of ſome years, in order to ſatisfy my curioſity, and to hunt it over in the remoteſt

remoteſt corners. At preſent I can only uſefully employ the ſhort ſtay which is allowed me; therefore I went the 13th from *Nagyag* to *Zalathna* here to examine the neighbouring mines. Our metallic rock *(Saxum metalliferum)* compoſes the mountains, over which the roughneſs of the roads allows no ride but on horſeback. Theſe argillaceous rocks are two hours journey beyond *Nagyag*, either entirely bare or covered with a reddiſh indurated ſhivery clay. Near *Barzcha*, a *Wallachian* village, riſes a ſtill higher calcareous mountain, ſuperincumbent on the before-mentioned ground. It ſhews every where indications of copper ore, and ſome adventurers have worked for it without ſucceſs. Near the village *Glut* the mountains ſlope into the plains and the limeſtone diſappears, inſtead of which the red ſhivery clay is ſeen again. Being diſſolved in its ſurface into a red mould, all the country about *Zalathna* ſeems to be red coloured. After a five hours ride I reached this place, which is at preſent, what it was in *Trajan*'s time, the ſeat of the upper court of mines. The many old inſcriptions offering hereabout, and mentioning the *Procuratores Aurariarum Daciae* and the *Collegia Aurariorum*, eſtabliſhed in theſe parts, make *Zalathna* extremely intereſting for antiquarians. *Zamoſci*, *Lazius*, *Koleſer* and *Fridwalzky* have compiled

compiled and publiſhed theſe inſcriptions. This place is ſituated in a pleaſant valley, interſected by the river *Ampoi*.

The *Wallachians* conſider this town as the metropolis of their nation in *Tranſſylvania*, and repair to it in the market days. The greater part of the buildings are inhabited by mining officers.

The adminiſtration of the mines eſtabliſhed here differs from that in the Bannat in this circumſtance, that every ſociety of actioniſts may as they pleaſe work their mines independant of the royal officers, under the condition however to deliver their gold and ſilver in the royal office at a fixed tarif of 300 florins a mark gold, and of 19 florins 30 cruziers the mark ſilver, with a deduction of five per 100 for fire loſs. Societies, that have not got any dividends, have now and then allowed them a higher price.

The upper direction is ſubordinate to the *Tranſſylvanian* chamber of finances at *Hermanſtadt*; but this in reſpect to the mines to the court chamber of the mines at *Vienna*.

The juſtice of the mines is independant of this direction, and decides the variances of the different ſocieties and the miners. Beſides there is a royal gold office, where at certain days the waſh-gold of the *Wallachians* and gipſies is bought at a fet-

tled

tled price at two florins thirty cruizers per piſeth; three piſeth three denarii being equivalent to one ounce of gold. If the gold be already purified by mercury, it is bought fifteen cruizers dearer.

This office is a great advantage for the poor *Wallachians*, ſince they are enabled by it to ſell every week without impoſition whatever be their ſmall proviſion. As commonly the gold-grains ſold to this office are ſcarce three or four denarii weight, it is impoſſible to aſſay each ſeparately, and to pay them according to their proof and real value. Hence ariſes the neceſſity of an equal price, without any reſpect to their different interiour value, and conſequently an opportunity for the *Wallachians* to adulterate and heighten the weight of their gold by a mixture of ſilver filing, as ſoon as they are convinced of its ſuperior purity. You ſcarce would imagine that theſe ſmall and trifling grains of the *Wallachians*, amount every year in the whole country from ſeven hundred to a thouſand weight of fine gold.

Not to loſe any time I haſtened after dinner to the rich *Maria Loretto* gold-mine on the *Facebay* mountains, near *Zalathna* to the north. After half an hour's journey I reached the foot of the mountains, covered with argillaceous ſlate, ſuperincumbent on grey horn-ſlate. The mountains riſe gently; however, at firſt ſight of their high

high elevation they ſeem to be ſteep and inacceſſible. At an elevation of 150 fathoms the ancients have driven the *Sigiſmund* gallery. According to a traditional ſaying it was begun in the fifteenth century, under king *Sigiſmund*, and yielded then amazing treaſures; but conſidering its having been cut through a ſolid hard hornſtone, above 300 fathoms in length and ſix feet high, its ſides being fair and even as ſtone-cutters work; and the length of time requiſite to work out ſuch a long way without blaſting, one is rather inclined to look upon it as a work of *Roman* ſlaves condemned to the mines. Perhaps the works were only taken up again under king *Sigiſmund*. It is remarkable that this gallery is driven in a ſtraight line and direction to the fiſſure; and hence it appears to demonſtration, * that the *Romans* knew to apply geometry to ſubterraneous

* If it was proved to demonſtration that the *Sigiſmund* gallery really is a *Roman* work: however, we need not be anxious about their ſubterraneous geometry. The *Grotta di Pauſilippo*, the ſubterraneous aqueducts from *Lago Albano* near *Caſtel Gandolfo*, the ſtupendous *Cloaca maxima* at *Rome*, and many other of their buildings, are unqueſtionable evidences of their ſkill under-ground; and they might, as well as our common miners in *Derbyſhire*, with a ſimple board, or rude *tabula prætoriana*, take up the ſubterraneous angles, and by that means, without any magnetical needle, hit under-ground whatever point they pleaſed. (Tranſl.)

works

works of this nature. In the roof of this gallery are ſome indications of former air-conductors, and theſe ſeem to have been conſidered in its height. The vein runs from ſouth to north, and is croſſed by the above gallery, which runs in weſt.

Quartz and *Hornſtone* (*Petroſilex Cronſtedt*, §. 62.) are the vein-rocks, in which offer the auriferous pyrites. Theſe contain from two upwards to ten, twenty, forty, nay ſometimes more ounces of gold. Beſides an auriferous pyrites of four ounces value, they find a common grey clay, which yields ſome gold by waſhing.

This mine is not at preſent under the moſt fortunate circumſtances. Superincumbent on it is grey clay and argillaceous ſlate, which probably ſeem to be the rocks of the *Maria* mine, ſituated ſomewhat higher to the weſt. I could not ſee it; ſince I was to examine the famous *Loretto* mine and then the return.

About fifty fathoms above *Sigiſmund* mine I met with the ſandſtone, which is the rock of *Loretto*, and accordingly is ſuperincumbent on argillaceous ſlate. The gallery was driving in a finer yellowiſh ſandſtone. *Cos particulis diſtinctis.* Then followed a ſpecies of ſtone, which is called *backſtone* and conſiſts of blunted rocks ferruminated by common clay. *Breccia arenacea*, *Cronſtt.* §. 275. Afterwards came grey hornſtone, *Petroſilex*,

Petroſilex, in which two veins, fourteen fathoms diſtant from and parallel to each other, are running. One is called the ſilver the other the gold vein. Both have ſmaller concomitant ramifications. The ſilver vein contains auriferous fallow ore, yielding up to eight ounces of ſilver per hundred, and its ſilver twenty and more denarii of gold in the mark; however, according to a common ill opinion againſt the ſilver mines in *Tranſſylvania*, it is not working. They are the more aſſiduous in the gold vein.

In the midſt of the grey hornſtone is a round cone or wedge of ſandſtone, as forced in from the turf. It is from two to three feet diameter. They have ſunk in it a ſhaft eight fathoms deep. This ſandſtone conſiſts of a variety of ſucceſſive coarſe and fine grained, grey and yellow horizontal compact ſandſtone beds, of a different thickneſs; ſome being not above one inch, ſome above a foot in thickneſs. Every bed has a particular gold mixture, which ariſes from the auriferous pyrites ſprinkled more or leſs in theſe ſandſtone ſtrata. One of the inferior beds for example yields four ounces, the ſuperincumbent one 100 ounces, another two ounces, another fifty, and another ſtill ſuperior to thoſe 200 ounces gold per hundred weight. As far as I may judge by the ſamples which I have taken with me, it ſeemed

to me that the finer grained ſandſtones are the richeſt. However, the inſpector and chief proprietor, Mr. *Weiſſe*, aſſured me, that this obſervation is not general.

Another circumſtance in this problematic mountain puzzled me ſtill more. I obſerved in the grey hornſtone a great number of round holes, three or four inches deep. At firſt I conſidered them as the remains of blaſting-holes; but enquiring after the reaſon of theſe ſo numerous miſcarried blaſtings, I was aſſured that theſe holes are natural to the rock, and that each of them naturally contains a blunted pebble. Really I found in the greater part of them blunted pieces of ſilex, or of indurated clay, which ſeem to have been hardened and blunted by rolling before they were incloſed in this hornſtone. I here frankly confeſs my ignorance. It is impoſſible for me to explain the origin of this paradoxical mountain, or with the utmoſt ſtretchings of my fancy to create a tolerable hypotheſis. See whether you can aſſiſt me, or whether your obſervations in other parts of *Europe* enable you to explain this phænomenon.

This mine I fear will not be long working; becauſe, whatever be its riches, it ſeems to be in a diminiſhing ſtate, as the veins in the hornſtone begin to break off; and after the draining of the little

little ſtockwork of auriferous ſandſtone no great hopes ſeem to be left, nor any probable chance to make new valuable diſcoveries within the ſmall compaſs of a ground which is at the top of the mountain. This is the more to be apprehended, as, by an unaccountable neglect, they have not thought in ſo rich a mine of a deep gallery or drift, which being driven a-croſs the whole mountain, would moſt certainly have laid open, whether or no there are other veins and riches under-ground. They have but of late begun to drive a gallery under the pit, which will enable them to ſink it ten fathoms deeper.

The ores of the *Face bay* mountain are remarkable phænomena for mineralogiſts. Common pyrites of no promiſing appearance contain from two to 600, nay to 900 ounces gold. On ſome pyrites the gold appears in a metallic form; on others it is ſprinkled as *Spaniſh* ſnuff (*Brunnich's new edition of Cronſtedt's Mineralogy*) on many others no gold is to be diſcovered by the ſtrongeſt microſcopes. This ſpecies may be ſtampt to the fineſt powder, and no waſhing will produce the leaſt ſuſpicion of any gold-duſt.

The workmen know their inner value at firſt ſight, and they are ſo very ſkilful in ſeparating the ores according to their value, that the aſſay-maſter of the proprietors makes no other ſorting,

but takes of each ſort a general proof; whereupon they are delivered to the royal furnaces to be aſſayed again by a royal officer, and to be paid their thus ſtated value.

Any bit of theſe pyrites brought under the muffle, or to any other fire, the gold appears preſently ſweating out on the ſurface in little globular grains. The ſame happens with the gold-ores from *Nagyag*. This circumſtance has cauſed ſome mineralogiſts to ſuppoſe, that the conſtituent parts of the gold, hid in the ſubſtance of the ore, unite by the fire, and that the wanting parts, probably the requiſite phlogiſton, being added by the heat, facilitate the operation.

The ſtamp-ores, conſiſting commonly of fine pyrites, ſprinkled in the hornſtone, and digging next to the veins, are roaſted to make them brittle. But that cauſes a ſenſible loſs to the proprietors, ſince the fire expelling the gold from the ſweating hornſtone in the form of a fine duſt, this precious powder is too eaſily carried away by the waters of the ſtamp trough. This bad practice is entirely owing to the nature of their ſtamp-mills. Their pound-rammers or grind-peſtels *(pochſtempel)* being armed inſtead of iron *(poch-eiſen)* with black or grey hornſtones, cut into the requiſite form, the roaſting of their hornſtones is neceſſary in order to make them

them brittle. In general, theſe ſtamp-mills are extremely imperfect. They are uncovered; accordingly every rain and flood carries away a good deal of their pulverized ores. Their water wheels are too ſmall; hence ariſes a great loſs of water. The duſt channels are of the ſame width, and have no inclination at all; hence no ſuch thing as a ſeparating the richer from the poorer duſt. I have ſhown all theſe deficiencies to the mill-maſter, and to convince him of the bad conſequences of his ſtamping, I cauſed ſome ſands from the firſt and laſt channel, and even from the flood or the brook that runs by, to be waſhed in his preſence, which clearly ſhewed that all theſe ſands are equally rich, and that the gold in the brook-ſand is downright loſs to the proprietors. But for ſuch people old cuſtomary practices are above reaſon and conviction.

Four hours journey from *Zalathna* to the eaſt is *Abrud-banya*, the former ſeat of the upper mine-council. Red, and now and then grey ſchiſtous clay, covering our metallic rocks, appeared in all the mountains about *Abrud-banya*. The moſt remarkable ones are *Igric*, *Cſetate*, *Boylor*, *Korna*, *Orla*, *Kirnizel*, *and Kirnik*. It is impoſſible for you to form an idea of their workings. The whole *Kirnik* mountain is from every part and ſide perforated with many hundred galleries, which

do not penetrate above ſome fathoms into its inner parts. Though this ſeems to be extremely bungling and aukward, it is leſs ſo in reſpect to the nature of its fiſſures and veins. Its numerous gold-veins are thin and ſhort. The adventurers have allowed a field of three fathoms in the hanging and as much in the hading ſide. They commonly begin working on a vertical fiſſure, *(ſeiger kluft.)* which they work for ſix or ſeven fathoms; then it begins to dip and to be inclined, and inſenſibly it turns flat; that is, according to the nature of this mountain, it turns rich and yields native gold. But it continues ſcarce above two fathoms flat and noble; ſince ſuddenly it turns again and breaks off. The miner knows by experience, that now he is at the end of his hopes on this fiſſure; therefore he drops it for another, or ſearches in the old drifts, till he meets with ſome worthy remains of the old man. Hence that innumerable quantity of galleries or holes.

A *Roman* inſcription, decorated with miner-inſtruments like ours, and found near this place, is an evidence that the *Romans* worked here.

Now and then extremely rich and ſhowy ores are found; however, the proprietors, being often at work during ſeveral weeks without any ſucceſs, are generally poor, and think themſelves happy by getting

getting a week the ſcanty revenue of three or one $\frac{1}{2}$ florin. The greater part of the inhabitans have no trade but this mining. The father is commonly buried in his mine; the ſon carries the ores to the mill; and the women take care of their ſtamping. The children gather the ſands and the mud, which by rains is carried in the valley, bring it to the mills, and it generally yields ſome gold.

To have this ſingular *Kirnik* mountain the better examined, a gallery 300 fathoms in length is driven under it at her majeſty's expence; but it has croſſed only ſome deaf veins, has freed the workers from the day waters, and is left at preſent to their further diſpoſition. The valley in which the ſtamp-ores are preparing is called *Voros Patak*. I do not exagerate in telling you that there are in it above 300 ſtamp-mills, which ſet at work make a noiſe ſo as to be heard at an hour's diſtance. But they are as the common ſtamp and waſh-works of the gipſies, without any covering, and with a ſingle ſand-channel. Inſtead of the ſtamp-iron they uſe here a grey hornſtone from *Koroſbanya*, which *P. Fridwalzky* is pleaſed to call calcedony. I cannot be convinced of the aſſertion of the mine officers, that they ſtamp and waſh here without any loſs; and you will rather agree with me, when I tell you, that the inhabitants of a neighbouring village, called *Kerpenes*, live entire-

ly upon the neglect of thoſe at *Abrud-banya*. They dig holes, in which they convey the ſame brook which runs through *Voros-Patak* valley, and another which drives the ſtamp and waſh-mills at *Bucſum*. The ſands carried in theſe ciſterns are auriferous, and pay richly the pains of a new waſhing at *Kerpenes*.

There are ſeveral other gold-mines in this neighbourhood as near *Bucſum* near *Abrud-Zeller* and in mount *Volkoi*. They conſiſt generally of auriferous quartz-veins, left by the ancients, and now worked over again by the *Wallachians*.

Near *Zalathna*, in the *Barſa* and *Ruſina* mountains, are *Peter Paul*, the *Three Kings*, the *Saints*, and ſome others. A great many more have been abandoned; and ſeveral of them yield auriferous lead-ore, nay, ſome native gold, but to no great advantage.

I cannot paſs ſilently over the two mercurial mines at *Zalathna*. The firſt is to the north of this place, at an hour's journey from *Dumbrava*. *The cinnabar* ore (*cinabaris ſolida, textura ſquammoſa, Sqammis minimis*) breaks here in a vein, and in a matrix of quartz and ſparr, incloſed in argillaceous black ſlate and ſandſtone. The vein runs from north to ſouth, but is leaping, often a fathom thick, often compreſſed and deaf. The ſecond is to the ſouth in the *Baboja* mountain. Its ore is granulated

granulated cinnabar, digging in a vein, which runs in limeſtone. Probably the ancients dug here great quantities of cinnabar. At preſent the *Wallachians* ſeek here after the remains of the old man. Some ſocieties however have united of late to undertake regular workings at *Baboja*. The mercurial ores are delivered to the furnaces at *Zalathna*, but the annual amount of clear quickſilver is not above three tons. They clear it by common diſtillation in retorts and alembics filled with water. If they told me truth, there is of late built at *Kisfalu*, near *Clauſenburg*, a ſublimating furnace for preparing ſublimat-mercury

LETTER

LETTER XIII.

Nagyag, July, 1770.

THE firſt mining place, which I met with the 16th on my excurſion to the mines weſt from *Nagyag*, was *Cſertes*. My father had here thirty years ago a rich ſilver-mine, called *Trinity*, which yielded a good revenue. But the ſituation of the ground making a deeper draining gallery impoſſible, and the want of ſufficient water for the pumping-engines forced us to give it up. The mountains to *Cſertes* conſiſt of metallic-rock, covered with common argillaceous ſlate. But the *Bogaja* mountain, in which the above mine was working, conſiſts of ſound compact hornſtone; the veins, which croſs it, are very rich, and yield auriferous glaſs-ore, cloſely woven in the ſubſtance of the hornſtone. The rocks are ſo remarkably hard, that even with blaſting the works advance but little. *P. Fridwalzky* adviſed therefore in his Mineralogy to ſoften theſe refractory rocks by bacon ſuſpended and ſet on fire before the drifts. *O! Sancta ſimplicitas!*

A new

A new ſociety of adventurers has at preſent undertaken to drain this mine by a new gallery. But as it is to be driven a long way under ground, and nevertheleſs cannot go any conſiderable depth, I am apprehenſive that, though the drained part of the vein ſhould conſiſt of the richeſt ores, the expences will hardly be cleared.

In the adjacent hills are ſome gold-works, which in former times have given conſiderable dividends. Theſe are not in hornſtone (*petroſilex*) but in metallic rock.

The furnaces near *Cſertes* are employed with the ſmeltings of the neighbouring ſocieties. Want of water makes them often inactive.

The *Fourage* mountains near *Cſertes* have had in former times many mines. For the greater part they are given up. The inhabitants of thoſe parts aſſured me, that pieces of native gold, not lamellous but found as glaſs-ore, had been found there.

I went from thence to *Topliza*. The mountains conſiſt there likewiſe of that grey argillaceous rock, mixed with mica, ſherl or quarz grains, which I have preſumed to call metallic rock (*Saxum metalliferum.*) They are covered with argillaceous ſlate. The veins are commonly a quartzous auriferous ſtone, and conſtantly running from ſouth to north. Such is the vein of the *Nepomuck*,

muck, *Martinus*, *Rochus*, *Archduke Peter*, *S. Joſeph*, *Mary's Annunciation*, *Florian*, *Francis de Paula*, and the *Holy Croſs* in the *Magura* mountains. I was told that in *Nepomuck* native gold had been found immediately under the turf. Some of theſe fiſſures yield, beſides their native gold, fine auriferous red ſilver ore.

In the *Matſhire* mountains they drive at preſent a gallery, in order to drain ſome old works; and in the *Fiſher* and other adjacent mountains are ſome gold-works, which now and then yield conſiderable pieces of native gold, but very often are dead and deaf.

In theſe *Toplitza* mountains the gold is often found in lead-veins. The ſame happens in the more weſterly mines at *Fuezes*, whoſe rocks in the *Malula* hills are entirely correſpondent with thoſe at *Topliza*. Near *Fuezes* I found a grey looſe marle ſlate, inſtead of the common argillaceous ſhiſtus, ſuperincumbent on the metallic rock. Being diſſolved by the air, and conſidered as common clay, it had been employed to line the incloſure of a water reſervoir. The water diſſolved the lining, and the reſervoir waſhed its encloſure away. Without enquiring the reaſon, the ſame marle was made uſe of again of late, and laſt ſpring the ſame accident happened. At laſt they were ſenſible of the blunder.

The

The conſequence of this double unhappy expenſive accident would prove very happy, if people would learn thence to conclude, that a mining officer ſhould at leaſt be acquainted with the common foſſils and their qualities.

In *Clemens* near *Fuezes* there is native gold in ſelenite, or *gypſo ſpatoſo albo pellucido*.

On the oppoſite ſide of the *Malula* hills is *Trſztyan*, a place greatly renowned for its rich gold veins, and the magnificent ſhowy pieces of native gold which are found here every day.

As they have received in *Tranſſylvania* a principle, that native gold is to be found only immediately under the ſurface of the horizon, I was highly deſirous to examine this mine, hoping to find perhaps ſome arguments againſt that opinion, ſince for a very long time it has been worked to great advantage, and has produced an uncommon quantity of gold; which ſeems to me unaccountable, if the vein did not dip under the horizon. But the proprietor, Count *Stephan Gyulai*, ſcarce allows any imperial mine-officer to viſit his mine; and all the works, being ſuperintended by a *Wallachian*, are ſo barbarouſly bungling, that a man muſt be a *Wallachian* to hazard his life for his curioſity, and to ſlip down in the ſhafts wherein no ſuch thing as a ladder or other proper aſſiſtance is to be met with.

Therefore

Therefore I was confined to examine the nature of the mountain, which conſiſts of the ſame rocks as the *Fuezes* hills.

Better management would improve this noble gold-mine to a greater benefit for the proprietor. Being worked only by *Wallachians*, who never neglect any opportunity to pilfer, a good deal of the finer gold-ores may poſſibly be concealed by the workmen. Some years ago I ſaw myſelf in the market place at *Deva* a miner from *Trſztyan* publicly ſelling fine ſamples of gold-ore. Though of late ſome ſevere ordonnances are publiſhed againſt this illicit thievery and ſample ſelling, ſince it lowers the benefits of the royal gold office, it will however be very difficult to prevent the loſs of the proprietors, becauſe any miner may eaſily find an opportunity to ſell his ſtolen goods to the *Corſars*. This ſort of people ramble about in the remoter mines, buying from the proprietors their little proviſions of ſtampt gold-ores, which by themſelves would not bear the carriage to *Zalathna*. Having gathered their full load, they deliver and ſell them to the royal office. This trade ſeems to be an advantage to the royal office, as well as to the poorer adventurers and proprietors, but it degenerates too eaſily into a commerce which proves pernicious to the richer works, as the *Corſars* have certainly no objection to purchaſe the ſtolen ores at a cheap price, and ſufficient

ſkill

ſkill to pound and to mix them with the ſtampt ores, which they are allowed to buy and to ſell.

At night I reached *Boicza*. The mountains hereabout connect with thoſe, which at my arrival in *Tranſſylvania* I found ſtretching on both ſides of the *Maros* river. In general they conſiſt from this place to *Deva* of metallic rock, covered with limeſtone, ſlate or ſand. Some hills near *Boicza* are deſtitute of veins, conſiſting of blunted rocks, ferruminated by an argillaceous cement and reſembling *Breccia*. The royal mine is working in a variety of metallic rock, differing from the common ſpecies by large feldſpath pieces ſprinked in its ſubſtance. The uppermoſt or *Anna* gallery was driven in limeſtone, which is ſuperincumbent on the metallic rock, and covers large valleys; but the deeper gallery runs in ſandſtone till it reaches the argillaceous rocks. The veins and fiſſures are blendiſh-leadglance, containing ſome gold and ſilver. I have ſome ſamples with gold immediately ſticking on the blende and the lead glance. At the tenth fathom of the deeper gallery I found an argillaceous fiſſure nearly vertical, and in it a great number of blunted oval tranſparent calcareous ſparr-bullets with opaque milkwhite ſtripes, reſembling thoſe of onyx.

Limeſtone *(calcarius albus particulis granulatis minimis)* is hereabout a deteſted ſtone among the miners,

miners, ſince it cuts their veins or fiſſures. This however ſhould not diſrecommend the calcareous ſtones; ſince, according to the theory of ſuperincumbent mountains, it is of a more modern origin, and depoſited in the valleys in which in former times the veins and fiſſures baſſetted out. The blendiſh lead ores contain here commonly three ounces of ſilver, and the ſilver ſixteen denarii of gold per mark. The ſtamp-ores are henceforth to be prepared in three ſtamp mills, which are at preſent building after the model of thoſe at *Shemniz*. They ſtand on a ſloping ground, one above the other; pulverized ores to be waſhed in a great waſhing-houſe at the foot of the mountain, in which ten plane hearths will be ſet at work. A hundred weight of ſtamp ore gives eight pounds of metallic powder, the upper ſort yielding ſix the lower two ounces of ſilver. The mark of ſilver contains ſixteen denarii or one ounce of gold.

It was impoſſible for me to viſit the many other mines at *Boicza*; but I have got ſome of their ores as well as thoſe of ſeveral ſtill working mines in *Tranſſylvania*, and theſe you will pleaſe to take notice of by this following catalogue:

Auriferous pyrites in bluciſh clay; *argilla communi pleſtica cæruleſcente*, from *Herzigan* near *Boicza*. They do not work here but on the old man.

Auriferous

Auriferous pyrites in black hornſtone from *Ginel* near *Boicza*. Native gold to be found here in the ſame matrix.

Native hair-ſilver on lead-glance from the ſame place. The rock ſticking to this ſample proves to me that the *Ginel* mountains are metallic rock.

Auriferous quartz from the old works near *Ruda* and *Kriezur*.

Native gold in calcareous ſpar from *Staniza*.

Native gold in ſtarry radiate antimony. From the ſame place.

Native gold in grey ſcaly cobalt *(ſcherben kobolt)*. I aſſayed this cobalt, and had a gold grain left on the capell. The works at *Staniza* are in the *Jeſuina* and *Dimbul* mountains.

Auriferous pyrites in indurated ſhivery black clay from the croſs gallery at *Cajonel*.

Auriferous pyrites on quartz from *Gothelf* gallery at *Cojonel*.

Auriferous blende from the ſame place.

Auriferous lead-glance in hardened white clay from *Kißbanya*, where at preſent a company has united for working the lead-veins of that place.

Auriferous red ſilver ore on quartz from *Trajka* near *Trſztyan*. The vein runs in metallic rock.

Lead-glance in quartz from *Offen banya* near *Zalathna*. Of late a company has united to work the large lead-veins which have been diſcovered

there. The old works are of the ſame kind, it is not known for what reaſon they were given up many years ago. *Fridwalzky's* pretended reaſon is fabulous. The nature of the rocks, that is to ſay, argillaceous clay, ſuperincumbent on our metallic rock; the width of the veins; the great number of old bing-places; and the marks of thirty furnaces hereabout, have co-operated to raiſe the company into high ſpirits, and to undertake the works with activity

I got neither ſamples nor creditable accounts from the other *Tranſſylvanian* mines. However, to make my accounts of the known gold-works as compleat as poſſible, I will give you their names, taken from *P. Fridwalzky's Mineralogy.*

At *Nagy-Almas*, to the weſt from *Zalathna*, in the *Rudile Baba* and *Petraſack* mountains, gold is found in antimony, and in a ſpecies of ſtone which is unknown to me, and which *P. Fridwalzky* calls *ſpathor pyrites.*

At *Pojana* in the *Vertes* mountains, in the ſame tract of land, the *Wallachians* hunt after ſtampores left in the old works. In the year 1742 a blueiſh grey quartz vein with native gold was diſcovered by rain in the *Dimbul Kupiatra* mountain. It had its direction from eaſt to weſt; but as in general the *Tranſſylvanian* gold veins are very inconſtant and ſhort, ſo proved this likewiſe.

likewiſe. After a ſhort run it ſhifted its direction, turned and broke off. I gueſs from *P. Fridwalzky's* obſcure deſcription that it was in hornſtone.

At *Porkure* in the *Cſetras* mountains the *Wallachians* hunt after ſtamp-ores; which they afterwards ſtamp and waſh at their account. In the *Vallkurethe* mountains marks of gold-mines have appeared likewiſe.

At *Kiroſbanya*, a mining place in the bailliwick of *Wiſſenburg* and the *Mayura* mountains, a vein two fathoms thick is ſaid to be interrupted by ſmall auriferous fiſſures.

I reſerve the *Tranſſylvanian* gold-waſhings for the deſcription of my journey to *Upper Hungary*; and deſire you to return with me to *Nagyag* for the ſake of ſome iron and lead-mines on the other ſide of the *Maros*. The moſt remarkable mining place in the *Hunyad Comitat* is three hours journey from *Vaida Hunyad* to the eaſt, near a village called *Gyalter*. It produces a good deal of iron. The iron ores are found here, as in many other *Hungarian* iron mines in neſts, or ſtocks ſix or eight fathoms large, which have but an irregular and uncertain direction to the ſouth, and do not ſink into any conſiderable depth. The *Kropilela* mountains, which contain theſe ores, conſiſt of grey and brown argillaceous ſlate. The ores conſiſt

of red and brown iron ocher, in which ſometimes button-ore is wrapt up, covered with feather-like iron cryſtals, as the button-ore in the *hulf-gottes* mine at *Platten* in *Bohemia*. The workmen call this button-ore *iron-flowers*. *P. Fridwalzky* is a good deal wiſer; he calls it antimony.

The ſmeltings have nothing particular, being done in a ſort of ſmall high furnaces; and the iron is beaten into bars in ſeveral hammer-works along the *Cſerna*. The *Wallachians* and gipſies are in general blackſmiths and iron manufacturers. They uſe ſmall and low furnaces, and blow the fire by portable bellows made of bucks ſkin. Their conſtruction is very ſimple; conſiſting of a ſimple ſewing of the ſkin of an iron air pipe fixed in the neck, and of two wooden handles, fixed to the ſkin that covered the feet. The antiquity of theſe iron-works appears by an inſcription found near *Oſtrow* and ſpeaking of a *Collegium fabrorum*. Perhaps even the denomination of the *Porta ferrea*, or the paſs on the limits of *Turkey* is hence derived. This remark and conjecture is entirely *P. Fridwalzky's*.

Nearer towards the *Maros*, and a village called *Kiſmunes*, have been found ſome lead-veins in argillaceous ſlate, which of late have been undertaken by a private company. On the road I found calcareous hills, filled with a great variety of turbinites

turbinites and other marine ſhells. Theſe hills on the *Maros* are to be conſidered as the foot of the high mountains, which run by the *Haczeka* valley, uniting afterwards with the high *Granite*-mountains, between *Tranſſylvania* and the *Moldaw*.

There is hereabout but a ſingle natural curioſity remaining which I cannot leave unnoticed. Near the door of the deep *Joſephi* gallery at *Nagyag* I have found an hill about thirteen fathoms high, conſiſting of an innumerable quantity of regular pieces of metallic rock. They are flat, and about a foot in thickneſs. This hill cannot poſſibly have been heaped together by human hands, nor is there any old mine to countenance this opinion. Beſides, theſe ſhivery ſtones are exactly fitted and joined one to another; are not mixed at all with any other ſpecies of ſtone, and ſpeak at firſt ſight that by ſome accidental cauſe they are ſplit and cracked into ſo many regular fiſſures and fragments. But what accidental cauſe? A concuſſion ſubſequent to the exſication of the rock ſeems to be a very probable one; but I have better reaſons to conſider theſe ſtones as volcanic productions. They are of a coarſer texture than the common metallic rock at *Nagyag*, and are ſonorous. I know that mineralogiſts will ſtart many objections againſt this opinion, as in a great

a great diſtance no exſtinct volcanos are to be met with. Therefore I deſire you would examine this ſhivery ſtone, and a ſimilar ſpecies from the volcanic *Euganean* hills near *Padua*. Samples of them you will find among the *Tranſſylvanian* foſſils, which I have collected for you.

LETTER

LETTER. XIV.

Near *Foldwinz*, *June* 24, 1770.

FATIGUED by the heat of the day I arrived here, where, except ſome graſs for the horſes, no accomodation is to be had for the paſſengers. Unable to ſwallow the ſour wine of my poor landlord, I drank a glaſs of water. I think of you, and write to you an abſtract of my journey from *Nagyag*. I left that place yeſterday. When I had paſſed the metallic rock-mountains, which are covered with ſlate, I got into a plain, now and then interrupted by argillaceous ſlate-hills; then I reached the *Maros* to the right. To the left near *Bobolna* we had mountains of ferruminated clay and pebbles, as thoſe near *Boicza*. They ſeem to have been heaped and waſhed together by the *Maros*, ſince their ſloping to the river is leſs indurated, and a piece of tile ferruminated with other pebbles, which I found near the road, is a good evidence of their ſucceſſive and modern origin. The hills of the ſame nature, which are more to the north, and thoſe at *Boicza*, which are likewiſe on this ſide of the *Maros*, had pro-

bably the ſame origin, and accordingly this river ſeems to have ſhifted its bed from ſouth to north and to ſhift it ever more ſince the plains on the other ſide do not confine it within conſtant bounds. Hereabout, but on the other ſide of the river, are the *Olapian* plains, times immemorial famous for their gold-waſhings.

The ſurface of theſe plains conſiſts of ſands and pebbles. After the removal of the turf and of the vegetable mould, this ſandy ſtratum, two fathoms thick, appears. Times out of mind it has been dug out, and yielded gold by waſhing. It is ſuperincumbent on argillaceous ſlate, which is deſtitute of gold. To the eaſt and weſt it is ſurrounded by hills, which in the ſouth connect with thoſe that divide *Wallachia* from *Tranſſylvania*. To the north it is adjacent to the *Maros*. It ſeems to owe its origin to ſome inundation, perhaps even to the *Maros*. The gold cannot poſſibly be conſidered as produced in this plain; it is probably waſhed by the rains from the adjacent gold-fiſſures and depoſited with the ſands. This conjecture gains ſome credit, becauſe gold has been of late waſhed with ſucceſs in ſuch places, which many years ago had been worked and waſhed out already.

In the night I reached *Carlſburg*, a fine fortreſs. It is my birth place, and I had here my education till

till the eighth year of my age. It is pleaſantly ſituated in a plain, ſurrounded by argillaceous ſlate and limeſtone hills. I met here with an *Hungarian* nobleman, who was very well acquainted with the gold-waſhings, eſpecially thoſe in *Tranſſylvania*. He gave me the following accounts, which I communicate to you, ſince I ſhall have no opportunity to examine theſe waſhings myſelf. All the *Tranſſylvanian* rivers and brooks, nay even the ſudden and momentary rain and mountain brooks are auriferous. But the *Aranyos* river is by far the nobleſt of all in that reſpect, and is compared therefore by the *Tranſſylvanian* Hiſtorians to the *Tagus* and *Pactolus*. The gold-waſhers are either *Wallachians* or gipſies. Theſe gipſies are not in the leaſt reſembling thoſe idle and lazy ones in *Hungary*. They are a laborious people, and honeſtly active for their livelihood. Some are ſtrolling fiddlers and muſicians; ſome blackſmiths; others deal in cattle and horſes; and the greater part has the gold-waſhing buſineſs. They pay their poll-tax every year with ſome hundred piſeths of gold; and ſell a good deal to the royal offices. They have great ſkill in finding and tracing out thoſe places where gold-waſhing is attended with ſucceſs. Their tools conſiſt of a board two or three feet wide, and four or five feet long, commonly edged on both ſides with

with a wooden brim. Woollen cloths are ſpread on it, and the ſands, poured with water upon it, leave the finer and heavier ſediments in theſe cloths, which afterwards are waſhed in a great water caſk, and then by the common ſevering trough ſeparated from the gold. If the ſands be mixed with coarſer gravel, the board has deeper croſs-furrows, in order to ſtop theſe coarſer ſtones, and to examine them for gold, which often is found viſibly ſprinkled in their ſubſtance. Such is their manipulation at *Topanſalva*, near *Abrubanya*, and all along the *Aranyos*.

Another practice common in *Tranſſylvania* is to dig pits, and to catch and ſtop in them the ſand and gravel carriage of the brooks, in order to ſever them from the gold-duſt or ores. I have obſerved the ſame at *Kerperes*; and it is practiſed at *Zalathna* on the *Ampoi* river, near the old mercurial mines, whoſe crrriages contain a good deal of mercurial ore.

The third method is to fetch the auriferous vein rocks from the old mines, and to clear them from the gold both by pounding and waſhing. This method is generally practiſed where plenty of water allows it.

This morning I travelled over a fine cultivated plain to *Enged*. Here is a *Calviniſt* academy, and ſome ſchools of that religion. The adjacent

jacent hills calcareous; the whole place built of pale yellow ſandſtone ferruminated with lime. The ſandſtone, filled with plenty of petrified ſhells, and dug in the hills, which continued behind *Enged* to *Foldwinz*, and to the very place whence I write you theſe lines.

LETTER

LETTER. XV.

Clauſenburg, July 28, 1770

UNDER the moſt tremendous thunder and rain-ſtorm, which I ever beheld in my life, I arrived the 24th at midnight at *Torda*. Behind the place whence I wrote you my laſt the mountains are ever aſcending. From the top, whence I had a ſight of the baſon of *Torda*, I diſcovered a great many hillocks, ſuperincumbent on this high elevated ground. Though I could not examine their nature, they conſiſt probably of the ſame grey limeſtone which covers the valley, and ſtretches to the *Aranyos*. *Torda* is on the other ſide of this auriferous river; the ſalt works half an hour's diſtance from the town on an argillaceous ſlate hill, which is ſurrounded by a great many little hillocks, ſaid to be calcareous, and proving at firſt ſight that they owe their origin, together with the ſalt rock-mines, to former ſeas. The whole plain on this high ground contains ſolid tranſparent *ſal-gemmæ*, probably ſuperincumbent on ſchiſtus. I could not examine it myſelf, and the miners were too unconcerned to know whether

whether their ſalt-rocks have a baſis of clay or of limeſtone, or of any thing at all. The turf and vegetable mould which covers them ſhews commonly white efflorescences of kitchen ſalt, which expoſed to the ſun tinge the whole ſurface with white. They are to be aſcribed either to the evaporations of the ground, or to the rain water running over the ſalt-bing places.

There are ſeveral mines or ſhafts ſunk in the ſame ſalt-rock ſtratum. Their conſtruction is particular. As ſoon as a ſhaft is ſunk and timbered in the upper earth bed, which is commonly from three to ſix fathoms thickneſs, they reach the ſalt-rock, and work down in it a conical pit, ſo that all the miners are employed on the ſame ſole. The number of the workmen is increaſed in the ſame proportion as the cone widens. At firſt ſight one might believe the whole ſalt ſtock through its thickneſs of thirty or forty fathoms conſiſting but of a ſingle ſtratum; but on nearer examination it appears to conſiſt of many accumulated parallel beds, of one or two foot thickneſs, which are either horizontal or undulating and ſeparated from each other by a thin layer of clay ſcarce the thickneſs of half a line. This natural ſeparation facilitates the breaking of the ſalt-rock, and is the more an advantage to the workmen, as they are paid only for thoſe pieces which are eighty pounds, the ſmaller

ſmaller ones being thrown on the bing places among the rubbiſh. For a piece of the requiſite weight they are paid half a groat; and whatever has the requiſite bigneſs is carried to *Carlſburg*, whence it goes by the *Maros Hungary*. I deſcended with five gentlemen into the *Thereſia* mine. Put all together in a wide ſack of rope net-work, and let down in the drawing-ſhaft; the ſack contracted by our weight ſo much that only our heads peep'd out. A miner was above our heads clinging to the rope which let us down, to avoid our claſhing againſt the ſides of the narrow ſhaft. This ſhaft is ſunk ten fathoms through the hardened clay, ſuperincumbent on the ſalt-ſtock; and a ſmall gallery is driven on the ſurface of the ſalt beds to bring away the waters ſoaking through the earth and clay roof, in order to prevent their falling down into the works. Beſides, there is a ſmaller ſhaft for deſcending and aſcending of the workmen; but the works below being of a conical form, the ladders cannot poſſibly be fixed to the ſides; accordingly they are faſtened by iron cramps or ropes one to another, and hang free and ſwinging in the midſt of the deep and wide cavern below. However, the workmen do not care, and being uſed to it, aſcend and deſcend theſe thirty or forty fathoms on ſwinging ladders as unconcernedly

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and nimbly as other miners in the moſt regular ſhafts. When we reached the opening of the ſalt-ſtock we hung free in our ſack, and I ſaw with pleaſure below me, in the depth of thirty-three fathoms, the many lamps of the workmen. I found in the mine the director of theſe ſalt-works, who had the politeneſs to ſhew and to explain whatever was worth ſeeing. I was agreeably ſurprized by a burning bundle of ſtraw, dropt down the ſhaft. It illumined the whole cavern, ſhewed me its conical form, unſupported by any timber, and made me diſtinguiſh the undulating form of the ſalt-beds. The light was from every ſide reflected by the whiteneſs and brightneſs of the ſalt-rocks. I have examined the clayiſh earth, which ſeparates their ſtrata. It has a ſouriſh taſte, but an offenſive diſagreeable ſmell, like that of rotten cheeſe. It is tough like clay. The preſent ſole of this work is fourteen fathoms diameter. The *Coloſer* mine, of the ſame nature and form, is ſixty fathoms depth, and fifty fathoms diameter.

Many old ſalt-pits are given up long ago. Theſe are entirely filled with water, which they uſe hereabout for bathing. I was preſented here with ſome tranſparent pieces of ſalt-rock with incloſed water drops; another piece contains moſs. I got here likewiſe a great quantity of the *lapis numiſ-*

malis

malis Tranſſylvaniæ, deſcribed if I am not wrong by *Bruckmann*. Gyps and alabaſter is very common hereabout. Pray tell me what is the reaſon that theſe ſtones are for ever to be found in the ſalt-works? Might not the ſaline acid perhaps be changed into vitriolic acid, and thus gyps be produced? I have gyps from the ſalt-mines in *Upper-Auſtria*, and from the *Marmaros*, where it is found between the ſalt-beds.

After having ſatisfied my curioſity under ground, I ſaw the immenſe piles of rejected ſalt-rocks which are under the preſcribed ſize. They are kept for no uſe; and ſevere penal laws forbid even the poor to make uſe of them. The reaſons which they gave me for this unaccountable ſquandering away of ſo uſeful a ſubſtance, were as follows: That to prevent ſmuggling pieces of the ſame weight were given to the carriers, and that the abundance of the *Tranſſylvania* ſalt-mines did not ſeem to require any grudging, or ſending the ſmaller ſalt-pieces in ſacks or caſks. This might do, if the world was only to laſt but a thouſand years more; but good public œconomy takes care of the lateſt poſterity, and diſapproves any arbitrary and unneceſſary deſtruction of an uſeful mineral as inhuman extravagance. Many hundred millions weight of rejected ſalt are thus expoſed to diſſolving rain and ſnows; and what vaſt quantities are ſpent

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in a ſimilar way near and in the *Vizakna*, *Koloſer*, *Szekes*, *Deeſe* and *Paraite* ſalt-mines? Though *P. Fridwalzky* conſiders the *Tranſſylvanian* ſalt-mines as inexhauſtible ſtocks, he could not digeſt this cruel waſting of uſeful materials, and he had in this *Mineralogia Daciæ*, p. 171, the fantaſtical idea, to mix theſe immenſe ſalt-maſſes with tartarus, and thus to change them into nitre, in order to make ſublimate. However, there might be ſome chemical uſe of this waſting-ſalt. Might not ſaline acid be properly joined with urinous ſubſtances, every where to be had, and thus ſal-ammoniac be produced? You know of the ſal-ammoniac-manufactory of Mrs. *Gravenhorſt* at *Bronſwic*. Might we not poſſibly expect a greater advantage from our ſuperfluous ſalt-rock pieces, than theſe gentlemen can get by their ſcanty and aqueous brine?

Clauſenburg, two hours ride diſtant from *Torda*, is divided from this laſt place by a high mountain, conſiſting of argillaceous ſlate, and offering from the middle to the top a great many globular ſtones, three, four, and five foot thick. They conſiſt of yellow ſandſtone, cemented with lime and filled with petrifactions, ſuch as I found ſtratified near *Foldwinz*. Some of theſe ſtone-bullets are cloſely ſticking together; which ſuppoſes their having been connected when in a ſoft ſtate.

This mountain ſtands completely inſulated, and there is no higher mountain round about, from whence theſe bullets might have been rolled to this. Accordingly they ſeem to have been carried thither by the floods of the ſea, whilſt it covered this country. At the foot of this mountain lies *Clauſenburg*, one of the fineſt and moſt populous cities of *Tranſſylvania*. The *Roman* monuments, quoted by *P. Fridwalzky*, and found hereabout, prove that in former times it was a *Roman* colony. The houſes and even the walls, which incloſe this place, are built of grey or yellow limeſtone, filled with ſand and petrifactions. In general the country abounds in them; however, I have not found any ſcarce ſpecies. The deſire to converſe with a mineralogiſt, or rather my curioſity, prompted me to viſit *P. Fridwalzky*, living here in the college of the jeſuits. His rooms are filled with ill choſen ſtones, minerals and petrifactions confuſedly piled up. They bear the mark of their poſſeſſor's confined and unconnected ſcience. He is really a very induſtrious laborious man, but he has got together ſuch confuſed ideas of natural-hiſtory, that I am apprehenſive he never will be able to bring them into any tolerable order, or to diſtinguiſh the true from the falſe ones. This is rather owing to want of proper inſtruction and uſeful books, than to a deficiency

deficiency of his application or capacity. The desire to be useful led him to compile a *Mineral History of Transsylvania*; ignorant what science and experience is requisite to such a task. He supposed to have discharged his duty by giving the names of the mines, the length of the drifts, the depth of the pits, by compiling some accounts of mine-officers, a couple of charters and other monuments; and then, after all, telling his countrymen that this is a *Mineralogia Transsylvaniæ*. No such thing as proper descriptions or denominations of the rocks, and their local connexion and variety, which would have been material. At present there is scarce any hope of his improvement. The good-natured *Transsylvanian* noblemen look upon him as a great natural philosopher, praise his deep knowledge of nature, consult him, and by all those seducing undeserved distinctions hinder him from getting the better instructions by his masters in that part of science. Accordingly his future publications on Natural History will be but too much resembling the former ones. He seems to be sensible that his indigested accounts cannot recommend him to the esteem of true connoisseurs. His chief attention is therefore bent of late on other objects. He intends to make tiles from *asbestus*, paper from different vegetables, and borax from stalactites.

With ſuch propoſals he endears himſelf to ſome of the *Tranſſylvanian* noblemen, calls them his generous *Mecænas*'s in proper humility, and is to have from the provincial ſtates an annual penſion of 300 florins, in order to realiſe his projects and to continue his diſcoveries in Natural Hiſtory. It is a great advantage for *P. Fridwalzky, in iſta loca veniſſe ubi aliquid ſapere videatur.* I deſired him to ſhow me the ſtone from *Gyalupopi* from which he propoſes to extract borax. It was a common calcareous ſtalactites. Then he brought me his *ſtannum ſiculum* which he mentions p. 104 of his Natural Hiſtory. It was a black cryſtallized blende *(black Jack)* from *Kapnik*, which never will yield any tin. At laſt he procured me a ſight of the cryſtal, with incloſed gold, which he deſcribes p. 177. As I did not conſider this phænomenon to be very extraordinary, I little fancied that even in this he ſhould have been miſtaken. But the pretended cryſtal was common glaſs, containing within its ſubſtance a painted gold garland, ſuch as at a few cruicers expence you might buy by thouſands at *Turnau* in *Bohemia*. All this proved to me that the gold grains in grapes, the liquid fluid gold, and many other fantaſtical ſingularities which he pretends to have ſeen, to have examined, or to have heard of, deſerve no credit at all.

LETTER

LETTER. XVI.

Nagy-Banya, Aug. 2, 1770.

I SPENT two days in going from *Clauſenburg* to this place; and I had no leiſure either to ſee the iron-works at *Toroczko*, nor the lead-mines of *Runda* near *Biſtriz*. I had likewiſe no time to ſpare for the ſalt-works at *Dees*, becauſe I am to make great haſte, in order to return to *Shemniz* within the ſpace of time which I am allowed to be abſent. But I know by very good authority, that theſe ſalt-mines entirely reſemble thoſe at *Torda*, and that the ſalt produced is exported to *Hungary*. All the roads, and all the hills, which I paſſed, were covered by a pale yellowiſh lime-ſtone, containing many marks of broken ſhells. In ſome parts the micaceous ſlate, on which it is ſuperincumbent, appeared naked above ground. *Nagy Banya* is ſituated in a valley, ſurrounded by a tract of mountains, which runs from the north to the eaſt. It is a free and royal mining town, and was in former times, with its dependant mines, the conſtant domain and allowance of the queens of *Hungary*. In the ancient records it is

often called *Rivulus Dominarum*, on account of a brook which runs along the northern hills, connected with the *Carpathian* mountains. From such records it appears, that its mines have been worked already under King *Lewis* I. in the year 1347. King *Matthias Corvinus* left to the city, in 1468, the mint and the mines for an annual lease of 13000 gold florins. In the *Hungarian* laws, from 1519, two chambers of the royal revenues from mines are mentioned, one at *Kremnitz* and the other in *Rivulo Dominarum*. This and the very name of *Nagy Banya*, which is the *great mine*, proves the antiquity of its successful works. The ancients seem to have been very skilful in smelting and parting their ores. One hundred weight of of clear ore is said to have contained from 79 to 112 ounces auriferous silver. The poorer and mixed ores were in those times ground in common mills; and one hundred weight of the old slags yields scarce a drachm of silver. From the year 1526 these mines decayed by a successive variety of accidents, war and rebellions, till in the midst of the last century they were given up entirely. Such was their abandoned state till Baron *de Gersdorf*, one of the most intelligent mining-officers of the imperial states, proposed the renewal of the works in the *Kreuzberg*. Count *Gotlieb Stampfer*, whose character and mineral science you

are

are acquainted with, ventured himſelf by a ſmall gaping of an old gallery down into the mine, which he found drowned by water. With great danger he ſhipped in a ſort of ſkiff over the depth to the ſides of the vein, and gathering there ſome rich ores, he greatly encouraged a ſubſcription for draining theſe works.

To this purpoſe a deeper gallery was reſolved; and the ſucceſs being unqueſtionable, and the ſituation as favourable for ſmelting furnaces and ſtamp mills, as the account of the ancients, the proprietors purſue the undertaking with unwearied zeal, and have been theſe laſt ſeven years ſeriouſly engaged with their gallery.

It was at firſt driving for eighty fathoms in grey marleſtone; then followed dark grey hardened clay, and at laſt the metallic rock. This is the only mine at preſent working at *Nagy-Banya*. Several other fiſſures however are working by poor adventurers, but at preſent without ſucceſs. In the year 1748 a board of ſurveyorſhip of mines over ſeveral works, formerly belonging to the chamber of *Kaſſhaw*, was eſtabliſhed here; and ever ſince, the neighbouring mines at *Kapnik*, *Felſo-Banya*, *Fekete-Banya*, *Lapos-Banya*, and *Mis-Banya*, have been conſtantly in a more thriving ſtate. I ſhall examine all theſe mines, and ſet out to-morrow for *Kapnik*, which will procure me materials for a longer letter.

LETTER XVII.

Nagy-Banya, Aug 6, 1770.

HAVING the choice of all the places belonging to the *Nagy-Banya* inſpection, *vicit amor patriæ*. I went to *Kapnik*, a royal mine, in a rough country ſurrounded with mountains, and ſituated on the furtheſt limits of *Tranſſylvania*, formerly belonging to the *Tranſſylvanian* chamber, but of late ſubjected to the direction of *Nagy Banya*. It is four hours journey from this place, and the cliffs, which I met with going there, conſiſt of large naked granite-rocks and argillaceous glimmery ſlate. *Kapnik* lies in a valley. According to an old tradition the *Tranſſylvanian* princes are ſaid to have opened the firſt mine towards the end of the ſixteenth century. Its name the *Princes-gallery (Furſten-Stolln)* ſupports that tradition. The annual produce conſiſted then of four or 500 marks of ſilver, containing ſome gold. But the prevailing ground-waters put a ſtop to the works, which at laſt ceaſed entirely. In 1748 they were reſumed, which was occaſioned by the *Joſephi* mine, as having been ſold to the chamber by the impo-

impoverished proprietors for the trifling sum of 800 florins. *Kapnik* has at present the advantage over many other mining places, on account of many unattempted mountains, in which of late have been discovered the *Maria Hulf*, *Barbara* or *Joseph*, *Josephina*, *Kapnik* or *Ungarstoln*, *Erzbach*, *Theresia*, *Clemens*, *Peter Paul*, and *Christopher*'s veins, each working by different companies. All these veins run from north to south, dipping from west to east. The rock of these metallic mountains is a white argillaceous compact stone, resembling our *Saxum metalliferum*, except that it contains some spots of white stone-marrow *(lithomarga)*. The rock of the deaf and barren mountains hereabout consists of a blueish trap, striking some fire with steel. In some places both these rocks are covered with micaceous clayish slate. The princes-gallery vein is pursued already a length of 427 fathoms. In the present drift it is narrowed a little by the skirting rocks grown harder. Its common breadth is four or five fathoms. It consists of rosy-coloured feld-spath sprinkled with fallow silver ore. The pure fallow ore is melted separately; and the feld-spath goes to the stamp-mills. In the hading side of this vein runs a lead and blende-vein. Fourteen fathoms deeper are some smaller drifts working; but the rest is drowned in water, which the ancients

cients worked out by pumps, and henceforth will be carried off by the deepeſt gallery, which is to croſs and to drain all the veins together. *Petri Pauli vein* produces an auriferous white quartz, ſprinkled with fallow ſilver-ore, and now and then ſome neſts of a pale yellowiſh pure ſcarce coherent auriferous calcareous earth. The quartz contains grey plumoſe and pale yellow antimony, which is likewiſe found next with the vein in white clay, but then in coarſer cryſtals. I was told that the vein grows richer in gold wherever antimony happens to be found in it. I obſerved here on the hading ſide of the vein a cryſtalliſation, whoſe ſurface was all over covered with ſmall cubes. You know how curious I am of cryſtalliſations. I endeavoured therefore to ſeparate it from the vein, but found that this whole maſs of cubes conſiſted of a calcareous unpetrified earth. I obſerved the ſame phænomenon ſome weeks before I ſet out on the old *Anthony of Padua-Stolln at Shemniz*, where in the deepeſt ſole I found a large cube, which at firſt ſight I believed to be a hollow ſpar-cube, ſuch as I have many in my cabinet. When I touched this cryſtalliſation the ſmaller cubes, which covered the greater one, were found incoherent, nay liquid, and the greater cube yielded under the preſſure of the finger, and the water contained within run off.

off. Theſe facts prove that cryſtalliſations are continually producing in the humid way; and accordingly the many hollow cryſtals, which you have ſeen in my cabinet at *Shemniz*, have been in the beginning liquid lumps, whoſe ſurface cryſtalliſing in forms convenient to their ſaline nature, ſucceſſively hardened and left an empty cryſtalliſation after the water was evaporated.

The *Maria Hulf vein* is a hardened auriferous clay, ſprinkled with pyrites, waſhed in the waſhing-mills.

The other veins conſiſt of a pale reddiſh auriferous feld-ſpath, commonly ſprinkled with fallow-ore. The redder, that is to ſay the more irony it is, the more auriferous too. Moſt part of theſe fiſſures are ſeparated from the deaf rocks by a ſoft argillaceous ſkirt (*ſaalband.*) The deepeſt gallery at *Kapnik* has been driven already 700 fathoms in length into the above white metallic rock. It was begun by Baron de *Gerſdorf*. The veins croſſed by it are large and fine; but their auriferous quality diminiſhes in the depth. This gallery is to be lengthened 500 fathoms, and then it will drain the remoteſt *Furſten Stolln-vein.*

An hour's ride from *Kapnik* in the *Rota mountain*, is a private mine, which I examined likewiſe. The vein runs between a green indurated ſomewhat

ſomewhat calcareous rock, which is on the hading, and the white metallic rock, which is on the hanging ſide. It conſiſts of white quartz, mixed with blende and lead-glance. It is auriferous, nay the gold appears often in viſible native lumps.

The ſtamp-mills are in general of the ſame conſtruction as thoſe in *Lower Hungary*. However, the preſent upper inſpector, Baron *Smidlin*, has built one with ſix peſtels and double gutters. This really does a good deal of work in very ſhort time; but as the peſtels go very briſkly, and as more water is ſpent and to be given in the trough, I do not conceive this conſtruction to be any great advantage, ſince the impetuoſity of the briſkly running water does not permit the fine gold-duſt to precipitate in the canals, and conſequently a good deal is carried away.

They have here three ſmelting places with eight furnaces, both for the royal and for the private mines; the private reguli to be ſold in the royal purchaſe office, and the whole produce of gold and ſilver to be coined in the royal mint at *Nagy-Banya*. Their method of ſmelting is hardly in any thing different from that uſed at *Shemniz*. Baron *Gerſdorf* tried here an experiment, which deſerves your notice. He ordered a quantity of the rejected ſalt-rocks to be fetched from the neighbouring bing-places at *Marmoros*, and

and when the ſmelting furnaces were going, ſome troughs full of it to be thrown upon the works, according to the practice of the aſſayers, and in order to prevent the ſilver flying away in the fire. However, the effect did not anſwer the expectation; rather the ſilver was leſſened one half per hundred weight. But this was owing perhaps either to the neglect or the malice of the common ſmelters who are natural enemies to any novelty.

LETTER

LETTER XVIII.

Nagy-Banya, Aug. 22, 1770.

MY long ſilence is the conſequence of an unhappy accident, which was very near putting an end to my life. To examine the common firing at *Felſo-Banya*, and the great effects produced by ſo ſmall an expence of wood, I viſited the great mine when the fire was hardly burnt down, and when the mine was ſtill filled with ſmoke. An accident made me tarry ſomewhat longer in the ſhaft, by which the ſmoke went off. In ſhort I loſt my ſenſes, and fifteen hours after I was reſtored to myſelf by bliſters and other applications. My lips were ſwoln, my eyes run with blood, and my limbs in general lamed. Without the aſſiſtance of a ſkilful young phyſician at *Nagy-Banya*, and the great care of the upper adminiſtration's inſpector, Baron *Gerham*, in whoſe houſe I lodge, you would have been deprived of your friend; and the queſtion is ſtill whether he is to be ſaved. A violent coughing and acute pains in the loins, which alternately put me on the rack, are I fear more than ſufficient

to

to deſtroy this thinly framed machine. If that ſhould be the caſe, then my friend I deſire you to have my name at leaſt inſerted in the Martyrology of Naturaliſts.

Felſo-Banya is one of the eldeſt mining places. Formerly the inhabitants had no trade but mining; and in that reſpect they got from King *Lewis* II. a grant of freedom, dated 1523. The public troubles, which put a ſtop to all the neighbouring works, did not affect theſe, which continued uninterrupted to the year 1689. In 1690 the emperor *Leopold* bought the works at *Felſo-Banya* for 25,420 florins, granting by public charter eternal freedom from any taxes to the inhabitants: the mines have been ever ſince in a thriving ſtate. At preſent the *Borkul* and the *great mine* are the richeſt. Times immemorial the rock, conſiſting of grey hornſtone *(petroſilex)* is worked by firing, which in the upper ſoles has cauſed tremendous caverns threatning ruin, and not to be faſtened by any timber. In theſe ruins, or rather in this *old man*, ſeveral private adventurers hazard their lives in ſearching after remaining ramifications of ſtampores. I got from ſuch an old cavern a ſort of ſtalactites, which ſeems to me extremely problematical. It is very light, reſembling in colour a red yellow amber, vitreous and gloſſy where broken, reſiſts acids and the fire without giving any ſmell.

The

The *Borkul mine* has its hading and hanging ſides of the above hornſtone. The vein-rock is zinnopel, different from that in *Lower Hungary* only by leſs hardneſs. The vein is one fathom more or leſs, and contains ſtamp-ore, which yields but two ounces ſilver, the mark of ſilver yielding twenty denarii gold.

The great mine has likewiſe a vein like that of the pacher-ſtoln at *Shemniz*. In ſome places it is ſix fathoms wide. I went with horror over the ruins and the large rocks detached from the floor, till I reached the third ſole, which is leſs ruinous. On the fourth ſole a fiſſure coming from the hading ſide, croſſing the main vein in an acute angle, ſtrikes it deaf. The ſtamp zinnopel of this vein contains two ounces of ſilver, and the mark of ſilver forty denarii or two ounces and a half of gold. Some times they meet here with ore of ſixteen ounces ſilver. In a hanging fiſſure of this vein is found fine red, ſound or cryſtalliſed ſulphur, (ſandaraca) on white milky cryſtalliſed quartz; the ſame ſort of native ſulphur on yellow orpiment; white coarſe cubic pellucid fluor with incloſed ſulphur; grey plumoſe antimony; the ſame on quartz-cryſtals pointed on both ends, and cloſely ſticking together; red and graſs green antimony; grey coarſe radiated antimony on white pellucid rhomboidal priſms of fluor two or three inches in length,

length, which are perforated by the antimony, and prove that these minerals, however different in themselves, crystallised at the same time. I got likewise from the same vein red fine crystallised magnesia.

I have told you already that the mine is worked by firing. But this firing is different from that practised at *Goslar*, and at *Schlackenwalde* in *Bohemia*. The large ruinous caverns produced by it in those places, as well as on the upper soles at *Felso-Banya*, caused the proprietors to think of a more profitable and less ruinous method of firing. They sink their shaft by chissels, hammers, boring and blasting, to six, nine, twelve, fifteen fathoms. To contrive then a drift, a cut one foot high and deep is made to that side which they want to work. In it they place an iron grate, which they call the *pragel cat*, and it is to be covered with a layer of small pieces of wood, about an inch thick and one foot in length, and then to be set on fire. This softens and loosens the rock, which by iron levers is taken off from the sides and the roof, and facilitates the further firing, so far that no side-cut is requisite. The drift being widened by this method, and the vein over head to be obtained, they begin firing at its sole, covering it by a bed of two or three feet of deaf rock or stamp-ore, and lining the hading and hanging sides with

a wall of the ſame rocks, in order to prevent the flames ſpreading that way, and cauſing unneceſſary caverns. Then they proceed to ſet heaps of wood as noticed before. Such a heap conſiſts of about twenty-one or forty-two pieces of wood, three and three in layers a-croſs till they reach the roof. Twenty-four heaps requiſite for a length of four fathoms; and for theſe, together with the breaking down the looſened rocks, are paid to the miner twelve one-half cruicer and eight ounces of lamp tallow. By this method only the top of the flame works on the rock. They have an hundred ſkilful manipulations to direct it to the hanging or hading ſide, where they want it moſt. The looſened ores are left on the ſoles, new ſoles made of them, new firings ſet, and thus continued till the whole vein between two ſoles be broken down. The vein being extremely large, they begin firing in the hanging, going on to the hading ſide on the ſame level a-croſs the whole vein. The ſtamp-ores thus looſened are left in the mine as a magazine till they are in want of them, when they are carried under the ſhafts, and thence to the ſtamp-works. Thus the ore is procured at a cheap rate, a fathom of a drift by firing coſting not above fifteen florins, and requiring only two or three florins value of wood. The ſolidity and hardneſs of the rock is an advantage to this

manner

manner of working; cracked and broken mountain or vein rocks would be leſs acted upon by fire.

The vein rock of this large mine is zinnopel, a jaſper-like ſtone, extremely hard, ſcarce to be conquered by the chiſſel and hammer, and hard to be blaſted. However, I cannot be convinced of the great advantages of this apparently cheap and efficacious firing. Perhaps you will agree with me.

1. Whatever care be taken in lining the ſides it is impoſſible to prevent the flames from looſening the rock-ſkirts of the vein, which, unſupported by timber, of courſe break down, and produce thoſe unavoidable and dangerous caverns.

2. The fire volatiliſing and diſſolving the pyrites and the ſemi-metallic part of the ore, makes the air of this mine extremely unwholeſome, and affects the health of the poor miners, who ſeldom arrive to any advanced age.

3. The miners cannot, on account of the fire and ſmoke, work more than three days in a week.

4. The ores being pyritical, the fire carries too much ſulphur away, which of courſe leſſens the lech-ſtone and the ſcorification of the unmetallic parts.

5. It produces likewiſe an unequal ſtamping, ſince the fire affects the ore in a very different

manner, calcining ſome and leaving many more ſound and unhurt at all. In ſhort, a well directed croſs or oblique working would be, according to my opinion, preferable in many reſpects to this firing.

The great mine is at preſent ſunk 70 fathoms deep. Its vein runs in a metallic rock; and I am inclined to believe that the upper drifts are driven in ſuperincumbent hornſtone. The many fragments among the rubbiſh of the bing-places make me believe ſo.

The whole mountain of *Felſo-Banya* is underdriven or underworked by a deep gallery 454 fathoms length. The ground waters drained by two pole-pump-engines *(ſtangen-kunſte.)*

The royal ſtamp-mills at *Felſo-Banya* are of a good and regular conſtruction. Thoſe of the private companies are but too much reſembling to the common bungling ſtamp-works of the *Tranſſylvanian* gipſies

The ſmelting places are, one of ſix furnaces, royal; the other of two furnaces, the property of the city. The gold and ſilver produce to be delivered into the royal mint.

Companies who work ſtill for hope of a dividend have for a mark of their ſilver 21 florins 20 cruicers; and for their gold 77 $\frac{4}{5}$ ducats; but thoſe who get a dividend, or for other reaſons are deprived

prived of the higher tarif, are paid only 17 florins per mark ſilver, and 75 ducats per mark gold.

The unhappy accident which befell me here deprived me of the pleaſure to examine the other works and the ſalt-mines at *Marmoros*. What I know of them is as follows:

The ſalt-mines at *Marmoros* are ſurrounded with micaceous clayiſh ſlate, which continues to the granite-rocks of the *Carpathian* mountains. It contains thoſe fine pellucid octangular alum-formed quartz cryſtals, which, carried by the rains into the brooks, are gathered there and ſold under the name of *Marmaros* ſtones. They have a conſiderable hardneſs and natural poliſh. In the ſalt is found pellucid, white, fine ſtriped gypſum.

Fekete-Banya is a hamlet belonging to the city of *Nagy-Banya*. In 1645 above two hundred miners are ſaid to have been employed here for gold and ſilver; but at preſent it is a deſerted place. However, in 1752 the city of *Nagy-Banya* opened a mine, which to this moment is not very ſucceſsful.

Lapos-Banya is a metallic mountain, belonging to Count *Karoli*, and is divided into the *Miz-Banya* and *Sargo-Banya* mines. Theſe laſt have large ſtamp-ore veins, running in metallic rock,

and richer in gold than in ſilver. Now and then there is ſome lead-ore.

Miz-Banya has likewiſe copper. The gold and ſilver produce to be delivered into the royal mint at *Nagy-Banya*.

In *Olalapos* have been of late diſcovered ſome rich veins. I have from them a ſample of zinnopel, ſprinkled with native gold.

Near *Illoba* is native copper ſticking to lead glance. In the *Szamos* river herrings are ſaid to be fiſhed now and then, as has been aſſured to me by eye witneſſes. Near *Nagy-Banya* is a mineral well, frequently uſed by the inhabitants.

If you knew how much I have ſuffered to finiſh this letter, you would conſider it as the greateſt proof which you might expect of my friendſhip.

LETTER

LETTER XIX.

Shemniz, Sept. 5, 1770.

IT is impoſſible to tell you what I have ſuffered in my ten days journey from *Nagy-Banya* to this place. I was commonly carried into the coach and out again. Any ſtone in the road, any jumping of the coach doubled my pains. The dry coughing, which I cannot get rid of, does not permit me any reſt. Under ſuch circumſtances is was impoſſible for me to examine the mountains; and commonly the road went over plains in which I had the *Carpathian* mountains to the right, and the *Theiſſa* river to the left.

Schmolniz is on the promontory of the *Carpathian* hills. I ſhould have ſtrayed too much from the road if I had gone there. Beſides the recovery of my health, if any to be hoped, did make my haſte home neceſſary.

Near *Tockay*, in the fields and the vineyards, are found pieces of vitreous black and blueiſh lava, *Pumex vitreus Linnæi*, commonly called hereabout *lux-ſapphires*. I did not ſee hereabout any mountain, which might be ſuppoſed a volcano in former times. The hill, which is ſo famous for pro-

ducing the noble *Tockay* wine, conſiſts of argillaceous ſlate, and does not manifeſt any other volcanic marks. This makes me believe that theſe lava pieces have been rolled down and waſhed from the *Carpathian* hills, in which ſuch lavas and native ſulphur are very common.

A days journey from *Altſohl* begin the hills, which to the right ſtretch in the *Luptan* diſtrict, and thence join with the *Carpathian* mountains. Here I could not bear the jolting of my carriage; I was forced to ſtep out and to creep on very ſlowly. I obſerved vaſt quantities of looſe granite pieces. Probably ſome of theſe mountains conſiſt of granite; but as far as I might obſerve in paſſing by they are in general covered with argillaceous ſlate. Some lead-mines are working here; and as they told me ſome copper-mines too.

When I reached *Shemniz* the account of my accident arrived likewiſe; and as report heightens matters, I was ſaid to have not ſurvived it. My arrival was therefore a welcome conſolation to my family. Among a great many letters, yours were opened firſt: I rejoice on your happy return into your country. I have partly ſatisfied your demands by the accounts of what I have ſeen and obſerved; but I do not know whether I ſhall be able to give you a compleat theory of the nature

of

of the *Hungarian* mountains. However, I will endeavour my beſt in one of my next, and for the preſent I ſhall entertain you with the works at *Smolniz*, as deſcribed by me ſome years ago, when I wanted principles and experience for ſuch a taſk, and when I little thought that ſuch obſervations might prove an advantage to Natural Hiſtory.

Smolniz is a celebrated mining place, belonging to the royal domain, ſituated in the diſtrict of *Zips* on the foot of the *Carpathian* hills. It has very noble copper-works, known in the times of Count *Zapolia* and *Bathori* under the emperor *Ferdinand* III. The *Zips* county and *Smolniz* devolved to the Counts *Cſaky*, who in general lett the mines and the copper trade to foreign tenants. About the year 1671 *Francis* and *Stephen*, Counts *Cſacky*, divided their county and the *Smolniz* mines in two equal parts; but *Francis* having engaged in count *Tokely*'s rebellion, his part was forfeited to the crown. But the imperial chamber had no proper idea of this mine, and accordingly left this part to ſeveral private tenants, and in 1684 to the comproprietor count *Stephen Cſaky*, at a yearly rent of 4000 florins. Three years after the chamber worked this mine at a common expence with count *Stephen*, and its ſhare of the annual dividend was 14831 florins. This opened the

the eyes to the chamber, and made it think of the acquisition of the other part, which was obtained by an exchange in the year 1690, when the confiscated part of the county was returned to Count *Stephen*, and he prevailed upon to renounce his part of the mine, and the hamlets *Smolniz* and *Stoofs*, into the possession of the imperial chamber. Since this transaction the chief mines at *Smolniz* were royal estates, under the direction of the chamber at *Kaſhaw*; however, by want of proper principles, they could not be brought to any remarkable dividend. Therefore, in 1748, a formal general direction was established here, and the works were entrusted to a man of experience. The mines belonging under the general direction of *Smolniz*, are *Smolniz*, *Stoofs*, *Swædler*, *Einſiedler*, *Gollniz*, *Krumbach*, *Borathſhod* or *Wagendruſſel*, in the county of *Zips*, *Under* and *Upper Mezenſeiffen* and *Joſſaw*, in the *Abavira* district; *Tobſhaw*, *Roſenaw*, in the *Gomorha* district; *Iglo* or *Newdorf* and *Wallendorf* under *Poliſh* jurisdiction.

The mountains at *Smolniz* consist of a blueish glimmery argillaceous slate, in which the three veins at *Smolniz*, called the middle, the exterior lying, and the exterior hanging vein are running in hour six in the morning, dipping to the horizon in nearly seventy-five degrees. Hence it appears

pears that they are parallel. They are about twenty fathoms diſtant from each other; in their bendings they are ſtill nearer. The fiſſures between theſe veins are of no remarkable metallic value. The veins are ſubject to leaping, running ſometimes deaf a great length, and are affected in their run even by the leaſt change in the ſituation or nature of the ſkirting rocks. Theſe changes in the ſituation of the rocks are owing to ſmall fiſſures, which cut the run of the vein in a different hour or angle, and are called here *kleins*. By long obſervation of theſe croſs-fiſſures, and their effect on the main veins, the following rules have been laid down:

If the croſs-fiſſure be coming from the eaſt, it drives the vein into the hading; if from the weſt, it puſhes the vein into the hanging ſide, where accordingly it is to be found.

Fiſſures in hour nine or twenty-one, and dipping to the eaſt or the north, are called here *irregular* and *refractory* ones; *regular* fiſſures in the contrary are thoſe that keep the above run and dipping of the main veins.

Regular fiſſures, falling in with the vein, puſh it into the hading; but irregular ones into the hanging ſide.

Though theſe croſs-fiſſures or *kleins* very often interrupt the run of the vein, they are however requiſite

requſite to enable them, as generally they are deaf where theſe croſs-veins are wanting.

The middle vein is the richeſt. The ſecond in rank and value is the hanging; and in reſpect to thoſe the lying vein, as running beyond the mountain in the valley, is poor.

The rock of theſe veins is a dark grey clay, commonly mixed with quartz, but very ſeldom with ſparr. Generally the quartz begins and ends the ores.

The argillaceous ſlate between the veins contains frequently conſiderable neſts or lumps of pyrites. I have met with ſuch a lump, improperly called here a pyrite-ſtock, in a depth of fifty-ſeven fathoms, between the middle and the lying vein. They are rich of ſulphur, and contain two pounds of copper in a hundred weight.

The ores are generally yellow copper-pyrites, either ſuperficially variegated, or yellow and ſound or ſprinkled in glimmery dark-grey ſlate. Beſides theſe ores, whoſe richeſt ſpecies contains about twelve pounds of copper, the mines at *Smolniz* produce annually about an hundred thouſand pounds of cemented or precipitated copper.

The water which ſoaks through the fiſſures and veins is impregnated with copper-particles, diſſolved by the vitriolic acid. To impregnate it ſtill more, it is led into ſome old ſhafts, thence raiſed

raiſed by pump-works, conducted through ſeveral bing-places, and then poured in canals, which are dug near the ſhafts and filled with old iron. The vitriolic acid nearer related with the iron, is attracted by it, and accordingly precipitates the copper under the form of a ſoft powder. If the cement waters be ſtrong, this powder or ſediment is every third day ſeparated from the iron, to prevent its being incruſtated with copper, which would hinder its further diſſolution. It is obſerved that the copper precipitation ſucceeds ſooner and better in thoſe canals, where the vitriolic water falls with ſome impetuoſity on the iron. Every month the copper ſediments are gathered in the canals, the iron cleared and put again in the water, till it be entirely diſſolved.

Another equally profitable work is the picking up and waſhing of the bing-rubbiſh, conſiſting either of the neglected ores of the ancients, or of thoſe, which having been thought unfit for ſeparation in the mines, are carried to the bing-places. Theſe places are examined, the found ores ſeparated from the deaf rocks, and the copper ſprinkled ſlate pieces waſhed and ſieved as at *Shemniz*. The remaining unſhining pieces go to the mills. This buſineſs is carried on by children, ſervant maids, and old maimed miners, and produces every year about 60,000 pounds of copper.

The

The ſtamp-mills are of the ſame conſtruction as thoſe in *Lower Hungary*.

Thoſe ores that are too ſulphurous are by roaſting ſeparated from the ſulphur. Several ſulphur furnaces are built for that purpoſe. They are from three to ſix fathoms in length; from one to two fathoms deep, and two fathoms high. Commonly they have thirteen windows; and each window ſeveral openings, by which the ſmelted ſulphur runs out. The bottom of theſe furnaces is according to their bigneſs filled with three or four fathoms of wood; theſe wood layers are covered with ſome carts of charcoal; then comes a layer of ſound ſulphurous ore one foot thick, and this is covered with alternating waſh-ore-beds till the furnace be filled. The wood below is ſet on fire by a wood canal vertically ſet a-croſs the ore-beds. Such a ſulphur-furnace contains about 500,000 pounds of ore, which continues burning twelve or fourteen months. If the ſulphur ceaſes running from the openings, canals are dug in the upper covering of the furnace and paved with flat ſtones. Theſe canals, and wooden conductors laid in them, are led to a ſtone reſervoir; and as the riſing ſulphur ſteam is catched in the conductors, and cooled in the reſervoir, a greater quantity of ſulphur is got by this method than by the former. The depuration and ſublimation of it

into

into *flores ſulphuris* are known practices. The annual produce or ſaving of ſulphur is about 200,000 pounds.

The uſtulated pyrites ſerve here likewiſe in a vitriol manufactory. When ſtill warm they are put in tubs with water, elixiviated into a brine, and this boiled and evaporated in lead pans, which produces a blue-greeniſh vitriol, but the want of ſale makes this manufactory leſs conſiderable than it might be under more favourable circumſtances.

The common copper-ores require ten different roaſtings, one raw, and one black-ſmelting; after which they are refined with ſome lead, as not bearing the expence to part the little ſilver which they may contain.

The richer ſilver-mixed copper-ores are parted as in *Lower Hungary*, and yield at a medium from twelve to 1400 marks of ſilver every year.

Stooſs, in the diſtrict of *Zips*, is a dependant place of *Smolniz*, and furniſhes yearly about 500,000 pounds of iron, which for a great part is conſumed by the cementation works at *Smolniz*. The iron-veins are here running in ſlate; the ores conſiſt of brown or red iron-ocher, in a greater depth hardened into an iron-coloured ſound-ore, *Hæmatites cæruleſcens*. It contains now and then ſome neſts of yellow copper-ore.

Swadler,

Swadler, a market-place, is ſurrounded with large foreſts, and a great advantage to the royal chamber. The furnaces in the midſt of theſe foreſts ſmelt and refine every year about 200,000. pounds of roſe-copper. The company of private adventurers work here in rich copper veins, incloſed in glimmery argillaceous ſlate, which every year produce above 400,000 pounds of fine copper.

Einſidel, a place belonging to Count *Cſaky*, in the diſtrict of *Zips*, has rich copper-veins, which in former times produced conſiderable dividends, but for want of wood are but ſlowly working at preſent. However, they yield and ſell every year to the royal purchaſing office about 200,000 pounds of copper.

Golniz, in the ſame diſtrict, likewiſe belonging to Count *Cſaky*, is in time anterior to *Smolniz*. It has two rich copper veins, let to ſeveral companies. The royal chamber has large ſhares in them, and ſome conſiderable independant mines.

The veins run to the eaſt between horn-ſlate for a length of 900 fathoms. They dip into a conſiderable depth. The vein rock is grey quartz mixed now and then with ſpar. They yield yellow copper-pyrites, and grey copper ore, called hereabouts white ore, which contain fifteen pounds of copper per hundred weight, and from five

five to twelve ounces of silver. The whole annual produce of this place is about 600,000 pounds of copper.

Krumbach, in the same district, belonging to the same master, has iron veins in argillaceous slate-rock. In sundry places of this manor are rich copper veins, which annually produce about 200,000 pounds of copper.

Boratshod or *Wagendrussel* and its dependencies produce about 300,000 pounds.

Under-Mezen-Seiffen, *Jossaw* and *Upper-Mezen-Seiffen*, in the *Abavira* county, are three mining places belonging to the convent of *Premonstrate-friars* at *Jossaw*. This county is contiguous to the *Carpathian* mountains; the ground, consisting of argillaceous slate, rather working for iron than for copper-veins.

Topshaw, in the county of *Gomor*, on the river of *Gollniz*, has two capital copper-veins in argillaceous slate, worked by private companies. The different mines, belonging to this bailiwick, deliver aunually about 100,000 pounds of copper to the royal office at *Smolniz*.

Rosenaw belongs to the Archbishop of *Gran*, and is situated in the county of *Gomor*. In the territory of this place are copper, gold, and antimony veins. The large old bing-places at *Zingobanya*, near *Rosenaw*, speak rich old copper-mines.

Some years ago they have been taken up again, and yielded good copper-ores, containing ſome ſilver; but the adventurers being unable to afford the expences of pump-engines the works are dropt. The gold-veins diſcovered ſome years ago are dropt likewiſe. The four antimonial-veins run in hornſtone-ſlate. The ore is commonly found granulated and grey antimony; it ſcarce ever appears in cryſtalline or plumoſe forms. Near *Kraſznahorka*, in the county of *Gomor*, is a rich quickſilver-mine, which yields fine cinnabar-ore.

Iglo or *Newdorf*, in the county of *Zips*, is one of the thirteen towns which the Emperor *Sigiſmund* pawned to the crown of *Poland*. It has rich copper-works.

Wallendorf likewiſe pawned to the *Poliſh*. The mines belonging to this place work ſtill in hopes of a dividend.

The buying of the copper produced in all theſe places is a royal prerogative, according to which the different private companies are obliged to ſell their copper in the royal office at *Smolniz* at different prices, ſettled according to the different circumſtances and the different goodneſs of the copper. Theſe prices vary from twenty-nine to thirty-one florins; but the *Iglo* and *Newdorf* copper ſells thirty-two florins thirty cruicers. Three months after delivery the companies are paid in ready

ready money; which regular and conſtant ſale has brought theſe *Upper Hungarian* copper-mines into their preſent flouriſhing ſtate. The produce of the private companies conſiſts every year in 1,400,000; but that of the royal mines of 700,000; in all of 2,100,000 pounds of copper.

LETTER. XX.

Shemniz, Sept. 7, 1770.

YOU will not expect a compleat history of the *Lower Hungarian* mines, their origin, works, engines, furnaces, œconomy and produce; that would be a work of some years and of some volumes. Besides, you have been here and seen and examined yourself. You have read Mr. *Severini*'s treatise of the ancient inhabitants and the origin of the mines at *Shemniz*; and you may expect an account of the *Lower Hungarian* engines from Mr. *Poda*, who is resolved to give it to the press. Perhaps a description of our subterraneous and metallurgical-works might appear likewise, if the imperial order be brought into execution. It is, that the professors of our miner-academy are obliged to penn down proper hand books for the disciples, which are intended to be published at her majesty's expence. I want only to remind you of the nature of our rocks, of the rule of our veins, and of some observations thence arising, in order to support a short theory of all the *Hungarian* mountains, which

which to comply with you, I have reſolved to ſketch out.

The promontories of the hills, in which the noble veins at *Shemniz* are running, raiſe on the borders of the *Gran* river, where they conſiſt of ſlate, which afterwards unites with a harder, argillaceous grey rock, mixed either with ſherl, or quartz, or calcareous ſpar-grains.

This rock, which hitherto I conſtantly have called metallic rock, is the common mountain-rock, in which the veins at *Shemniz* and *Kremniz* are running. They unite with the *Carpathian* mountains.

In the valleys behind *Shemniz*, near the glaſs manufactory, and in ſeveral other places of the *Lower Hungarian* mines, hills of grey limeſtone are accumulated on the ſloping, nay even on the ſummits of this argillaceous rock.

The metallic rock near *Shemniz* contains three capital veins, parallel in their run with the direction of the river *Gran*, nay even with the bendings of its channel, as clearly appears by the mineralogical map of the *Shemniz* veins, which has been publiſhed by Mr. *Zipſer*.

The largeſt is the *Spitaler* vein. It runs from north to ſouth between twelve and four, and dips from weſt to eaſt from thirty to ſeventy degrees. In the remoteſt northern field this vein,

belonging to the *Nicolai* mine, was croſſed by a drift, and found deaf in the depth. Here it conſiſts of grey looſe and ſoft clay, mixed with ſpar. But the old rubbiſh ſeems to indicate that there were likewiſe rich and metallic veins in the upper level towards the day. Somewhat more to the ſouth, in the fields of *Michels* and *Pacher-Stolln*, it furniſhes good ſtamp-ores. Here the vein conſiſts of quartz, leadglance, and zinnopel; and the waſhed metallic powder contains a good deal of gold. In the field of the *Pacher Stolln* it is larger than any where elſe. On the twentieth drift or parallel for example, at a depth of 127 fathoms from the *Elizabeth* ſhaft, it is fourteen fathoms wide, and the deaf rocks included eighteen. This remarkable thickneſs of the vein has cauſed the croſs-works to be introduced. The company of the *Three Kings* and *Pacherſtolln* has here in the depth of the thirteenth level or drift, that is to ſay, in the depth of eighty-ſeven fathoms very rich ores, which in a greater depth change in zinnopel ſtamp-ores.

Further to the ſouth, near the limits of the *Windſhaft* field, an argillaceous white vein unites, and thence conſtantly runs with it in the hanging. The vein is from that place found to contain ſilver. The white clay of this hanging fiſſure offers now and then nodules of ſpar and quartz pieces.

Containing

Containing four or five ounces of ſilver per hundred weight; they are carefully gathered. At laſt the form of the vein is entirely altered in the *royal wind-ſhafts* field; and it conſiſts of broken quartz, which, if mixed with ſpar, yields richer ores of diſſolved pyrites and of an irony ocher, which ſeems to contribute to its increaſing auriferous quality.

This irony ocher decreaſes in the ſame proportion as the vein is advancing to the ſouth. The remoteſt field to the ſouth, diſtant from the northern about 3000 fathoms, is entirely deaf.

The *Johns* vein runs in a diſtance of 1000 fathoms in the hanging of the main *Spitaler* vein. According to Mr. *Zipſer*'s map, this vein ſeems to be the ſame which I mentioned before, as uniting or iſſuing from the chief vein. The vein-rocks or ſubſtance of this fiſſure is white clay, containing ſometimes ore, ſometimes metallic quartz, and ſometimes ſprinkled metal flakes. In its midſt occur now and then ſeparated and deaf zinnopel fragments, or diſſolved zinnopel. To the ſouth, on the fourth and fifth drift or level, its ſubſtance turns harder and richer; however, it has conſtantly in the hanging an argillaceous ſkirt or ſeparation of two or three inches thick, and in the hading a ſkirt of zinnopel about one foot thickneſs.

The mines working on the *Spitaler* vein are: the *Windſhaft*, *Pacher-Stolln*, *Three Kings-Stolln*, the *Glanzenburg*, *Michels-Stolln*, and the remoteſt northern *Dillner* deep gallery-works. I am to take notice here of a ſingular curioſity, which is that in a driſt driven on this vein, and in a perpendicular depth of eighty-nine fathoms from the *Elizabeth* ſhaft, I have found included in the ſound zinnopel a ſpecies of petrified porpites. * I am poſſeſſed of a fragment of zinnopel with ſeveral impreſſions of this marine body, and a porpites belonging to one of theſe impreſſions; both offered to me in a bing-place of the *Spitaler* vein, among the rubbiſh and ſtamp-ores, which then were carried out. The day after I went myſelf into the mine, aſking the workmen and officers whether this ſort of impreſſions and ſtones had offered to them in working out ſtamp-ores? They anſwered me in the affirmative, but unconcerned at their ſingularity had conſtantly rejected them under the ſtamp-ores. However, my endeavours to find ſome other ſpecimens for my mineralogical friends have been to no purpoſe.

* It is properly a petrified *Madrepora ſimplex, ſubtus plana, annulis concentricis, ſupra convexa, umbilico impreſſo, lamellis approximatis* in *ſuperficie granuloſis*. The ſame ſpecies, tho' hitherto undeſcribed, is common near the ſalt-works at *Gemunden* in *Upper-Auſtria*.

Now,

Now, my deareſt friend, tell me how theſe petrifactions may have been brought into a vein of a mountain, which cannot be ranked among the accidental mountains, and whoſe very rocks prove it to be of the primitive or original kind. If there were any higher ſuperincumbent calcareous hills, this phenomenon might prove leſs ſingular. But our calcareous hills are on the ſloping of the mountain towards the glaſs manufactories, and theſe petrifactions cannot poſſibly be carried thence to this high elevation, as none of that kind are to be found in the calcareous and lower ſtrata. However, a ſingle circumſtance ſeems to give ſome explication. You remember a hill to the north of *Shemniz*, which of late is decorated as mount *Calvaria*. It conſiſts of micaceous clay ſhiſtus, mixed with detached pieces of red jaſper, which greatly reſembles the deaf zinnopel. Petrified turbinites and chamites have been very often found about this hill; and ſamples of theſe petrifactions are in my cabinet. Might not, when this accidental hill was produced, and the whole country was ſtill under ſea-water, ſome of theſe cruſtaceous animals have been carried by water in the ſtill gaping fiſſure of this large vein? and by that accident have been brought into the maſs of zinnopel? § The detached jaſper pieces

§ If theſe petrifactions were of the ſame kind as thoſe in the before-mentioned hill, which is not, or the ſpecies of turbinites

pieces, mentioned before, ſeem to have been brought by ſimilar accidents in the *Johns'* fiſſure in the hanging of the vein.

The ſecond or the *Beaver Stollner* capital vein runs in a diſtance of 100 and 150 fathoms, in the hading of the *Spitaler* vein, parallel with it both in its run and in its dipping. The vein-rock is quartz mixed with pale yellow and reddiſh ſpar, zinnopel, and richer ores. In the hanging towards the *Spitaler* vein it contains zinnopel and lead ſtamp-ores; but in the hading is a ſkirt of clay, from one to four foot thick, with nodules of lead-ore, which yields from two to five ounces of ſilver. This vein has not been worked, nor found metallic ſo far to the north as the *Spitaler* vein. Near the *Amelia* ſhaft the *Daniel* fiſſure, ſtraying from the *Thereſia* vein, unites with the *Beaver Stollner* vein, and makes it richer. More to the ſouth in the *Chriſtina* field this vein has undoubtedly yielded the greater quantity of ore. Hereabout ſeveral regular and irregular fiſſures, ſuch as the *Althandle-*

turbinites and chamites, which are common in that hill, were likewiſe ſo in the zinnopel vein, which Baron *Born* would certainly have taken notice of, then the ſlate-hill and vein-rock of the *Spitaler* vein might be conſidered as produced in the ſame time. However, the vein rock may have been produced by ſimilar circumſtances, but in times anterior to the origin of that ſlate-hill. (Tranſl.)

Roſhka,

Roſhka, and ſome other hanging and hading ones, ſometimes unite and ſometimes ſeparate from it; eſpecially the *Wolf-gang* vein parts from it and runs towards the *Spitaler* vein. An hundred fathoms more to the ſouth, in the *Siegelſberger* field, this vein has its greateſt width, which is from four to five fathoms. However, it is croſſed by two ſmall fiſſures. They worked the firſt by galleries, and found on the ninth drift a vertical vein, till then unknown, which has ever ſince yielded the richeſt ores. The three hanging fiſſures, ſtraying from and running parallel with the main vein, yield likewiſe great quantities of rich ore. Beyond the *Konigſegger* ſhaft to the ſouth the vein is deaf at preſent. But the ſouthern part of the mountain is reſerved for the chamber, in order to examine the vein and to lengthen the works.

The *Thereſia* vein runs in a diſtance of 150 fathoms further in the hading, in a direction parallel to that of the two before deſcribed. On the higheſt part of the mountain it baſſets out, and is leſs examined than any other. To the north it dips from eaſt to weſt, that is to ſay, in a contrary and irregular direction; more to the ſouth it turns perpendicular; and further beyond the *Thereſia* ſhaft it dips parallel to the other capital veins at *Shemniz*, that is to ſay, from weſt

to

to eaſt. The vein-rock is lead-ore, mixed with zinnopel; however, in ſome fiſſures, eſpecially *S. Daniel*, it has yielded richer ores. Its ſoundneſs is the cauſe that the works on this vein are not ſunk above 150 fathoms, that is to ſay, to the ſole of the *Trinity* gallery. The zinnopel veins being richer of gold make amends for their being poor of ſilver. That is the caſe in this and the *Spitaler* vein. On the eleventh level, that is, in a depth of 116 fathoms, they have found in the midſt of the ſound mountain rock, when cutting a croſs door, or an oblique drift, a great number of bullets from one to two inches thick, conſiſting likewiſe of metallic rock, and being either looſe or ſticking to the other rocks. I am at a loſs to gueſs how theſe globular ſtones came into the mountain, or why they came to be produced in this form rather than in that of the other compreſſed rocks. On the *Klingerſtolln*, belonging to the *Thereſia* ſhafts field, I obſerved the remains and marks of old works, done before the invention of gun-powder, which the ancients called *pocket works* (*taſchen arbeit*) and produced by ſtrong and dry wood wedges, forced in the hanging ſide of the doors or galleries. Theſe wedges being wetted afterwards broke the rock by an effect of their expanſion.

I remember that in the deſcription of the *Spitaler* vein I mentioned deaf wedges, which frequently offer in the greater veins at *Shemniz*. They conſiſt of an argillaceous grey rock, differing from the metallic rock in a ſingle circumſtance, that inſtead of mica it contains ſpots of white lithomarga.

The width and thickneſs of theſe veins has probably occaſioned the great quantity of cryſtalliſations which are ſo common in theſe mines. Being filled with metalliferous ſubſtances there might have remained, or by their drying have been produced thoſe holes in which the cryſtalliſations are depoſited. They are generally filled, or at leaſt incruſtated within by calcareous, ſelenitical, or quartz cryſtalliſations. Suppoſing that their regular forms are owing to ſalts, as commonly is ſuppoſed, the variety of metals and ſemi-metals of the large veins at *Shemniz* ſeems to have naturally produced that great variety of fine cryſtalliſations which you have ſeen in my cabinet.

Thus I have communicated to you my obſervations on the chief veins at *Shemniz*. However, I add that they are worked with ſucceſs to the greateſt depth, ſince the auriferous zinnopel continues in vaſt quantities. Though this depth be about 200 fathoms, it is of no great importance in reſpect to the inner ſtructure of the globe, if

we

we conſider that, according, to Mr. *Podas* barometrical obſervations, made under ground, the ſeventh ſole in *Sargozi* mine being 158 fathoms below the *Charles* ſhaft, and 286 fathoms below the *Thereſia* ſhaft, is ſtill much above the level of the city of *Vienna*. Accordingly our ſubterraneous geographers have no reaſon to be proud of their diſcoveries of the inner ſtructure of the earth; even our deepeſt ſhafts have at moſt but ſcratched its exterior ſurface, and *Ovid's*

Itum eſt in viſcera terræ will be a poetical extravagance, till *Maupertuis*'s unphiloſophical propoſal of a ſhaft ſunk through the centre of the earth to the *Antipodes* be brought into execution

All the royal mines at *Shemniz* are drained and underworked by the Emperor *Franciſcus*'s gallery. Its door or entrance is five *Engliſh* miles from *Shemniz*, in the *Hodrizer* ground. It was begun in 1748, and happily finiſhed in 1765. Continually driven in ſound and hard metallic rock, and in a conſiderable height and width, it is to be wondered at even by connoiſſeurs how this immenſe and difficult work could be atchieved in ſo ſhort a time. It is lengthened ſtill further.

The private mines, working in other metallic veins, and belonging to the metallic court at *Shemniz*,

Shemniz, are to the weſt or to the north in the *Roſs ground* near *Eiſenbach*, or to the ſouth in the *Hodriz*. The *New Hope-Stolln*, the *Hofer Erb-Stolln*, *Windſchleuten*, and the *Old Antony de Padua Stolln*, are the moſt conſiderable mines in the *Roſs ground*.

The mountains conſiſt here generally of metallic rock; the veins, like thoſe at *Shemniz*, running from north to ſouth.

In the ſouthern valley is *Old All Saints Stolln*, a royal mine, which in former times yielded very rich ores, whoſe remains are ſtill working. The co-incidence of ſome large veins has produced here vaſt caverns, ſupported by the ſparings of deaf rocks. Here I found in a pit the year 777 cut in the rock. Might I hence draw a conſequence for the high antiquity of this mine? The rocks are here likewiſe our argillaceous grey rock, with this difference however, that it is as in all the other *Hodrizer* mines mixed *Lithomarga*.

Next to this mine follows *Finſter Ort* and *Brenner-Stolln*, whoſe vein-rock conſiſts of large auriferous and lamellated quartz, extremely light, very often as it were cut with a knife, but commonly in a ſtate of corroſion, and containing in its holes rich auriferous red and brittle glaſs ſilver ore. The *New Antoni de Padua Stolln* has a ſimilar quartz vein.

More

More to the weſt our metallic rock is covered with argillaceous ſlate, croſſed by iron and lead-veins. The ſame appears in the *Roſs ground* valley, where the ſlate begins near the *Eiſenbach* bath, and yields iron-ore, and now and then ſome fine load-ſtones.

I paſs ſilent over many ſmaller private mines to ſpeak now of *Belo-Banya* or *Dulln*, a mining place to the north of *Shemniz*. The mountains the ſame as at *Shemniz*, but an hour's way diſtant. The mines do not ſeem to have been of great importance in former times; and nothing is left but the names of ſome mines and the ſtill working deeper *Dullner Erb Stolln*. The *Dullner Nicolai* ſhaft is ſunk on the *Spitaler* vein, and belongs for the greater part to the royal chamber. I ſaw here on the *Seven Women* vein, in the northern field drift, ſeveral old blaſting-holes, one marked with the year 1637. *Roſsler* § relates, that in 1627 the blaſting of the mines was brought from *Hungary* and introduced in the *German* mines. But *Bayer* ſays, that in 1613 it was invented by *Martin Freygold* at *Freiberg*, an aſſertion which is repeated of late in the account of mines and their workings, publiſhed by the miner-academy at *Freiberg*.

§ Berg-Spiegel.

The *Maria Hulf* company works on a vein of auriferous pyrites. It runs from north to ſouth.

To the ſouth, on the other ſide of the *Reichawer* water-reſervoir, is a private mine, called the *Moderſtolln*, on a vein of auriferous quartz. It has given good dividends.

Further to the ſouth is *Baka-Banya* or *Bugganz*, a mining town. The mountains, like thoſe at *Shemniz*; ſome veins running to the eaſt. Sundry companies have of late taken up different old mines, in auriferous quartz and ſpar veins. The *Ladiſlai* company produces already a good deal of gold, which often appears in a granulated form.

Behind *Bugganz* the ſloping of the mountain is argillaceous ſlate, dipping under the plain which by *Tyrnaw* continues to *Preſburg*. On the northern ſide of *Preſburg* appear the roots of the *Carpathian* mountains, which near *Modern* are working for lead veins, mixed with aſbeſt and running in horn-ſlate.

I have noticed already in my laſt letter the *Schiſtous* mountains to the eaſt of *Shemniz*. To the north, on the ſloping of the mountains, are calcareous hills of white fine-grained limeſtone. They extend to the *Claſs-huttner* bath, which conſiſts of a hot well, uſed for many infirmities. The water

depoſits tophus mixed with iron ocher, and the canals in which it is conveyed to the bathing-houſe are incruſtated by it. Many tophaceous hills of the ſame kind are ſeen hereabout, and probably have been accumulated on the ſurface before the water was collected into canals.

Between *Creuz* and *Lehotka* is a fine cultivated plain. Marks of coals have been found here, and mentioned already by *P. Kircher* in his *Mundus Subterraneus*. Near *Lehotka* and the highway I found white ſhivery hornſtone, petroſilex, reſembling chalcedony and containing ſome petrifactions of plants or corals. Probably theſe detached looſe ſtones have been carried hither from *Leſkowiz*, beyond *Cremniz*. A rivulet, which flows here, comes that way; and ſound beds of ſuch milk-white hornſtone are found near that place, beſides a great number of detached jaſpers and achates, which are very common in the fields thereabout, and near *Deutſh-Littaw*.

The mountains at *Kremniz* are our common metallic-rock. The works are on a large and rich gold-vein and on ſome of its ramifications. The rock is white ſolid quartz, mixed with fine auriferous red and white ſilver-ore, and with auriferous pyrites. This pyrites, properly ſtampt and waſhed, contains from two to three drachms of gold per hundred. The vein runs from ſouth to north, and is auriferous above a length of 3000 fathoms

fathoms. It has been ſearched already to a depth of 150 fathoms, and is conſtantly found auriferous.

The ſame vein is, beſides the royal mines, worked by the *Rothiſh* company and the citizens at *Kremniz*. Fine ſtriated grey antimony found in the king's ſhaft. The whole vein being metallic, a great number of ſtamp and waſh-mills are eſtabliſhed here, and to great advantage directed by your countryman Baron *Watram*.

Further to the north, near *Tſhavoja*, ſome lead-veins are working in blue micaceous clayiſh ſlate, probably ſuperincumbent on metallic rock.

To the eaſt *Kremniz* is ſeparated from *Newſol* by a ſteep mountain, conſiſting of metallic rock and covered with ſlate. At its top, called the *Skalka*, red native ſulphur has been found in a grey ſuperincumbent ſand-bed. On the other ſide of the hill is *Tajova*, known by the royal copper- and parting-furnaces. Near this place cryſtalline orpiment, *Auripigmentum cryſtalliſatum*, *cryſtallis polyedris*, is dug from a blue clay vein in ſlate. The hills thence to *Newſol*, an hour's way diſtant, are calcareous.

This city is in a pleaſant plain on the *Gran*.

To the north, near the village *Jacub*, riſes the mountain *Baran*, conſiſting of argillaceous ſlate, accumulated on limeſtone and containing ſome copper-fiſſures. Nearer to *Herrn Grund* ap-

pears again the grey micaceous clay ſhiſtus, in which the mines are working. There are three chief veins, running from north to ſouth, and dipping from forty to fifty degrees from eaſt to weſt. The vein in the hading is called the *Copper-vein*; the ſecond to the hanging the *Herrngrunder-vein*; and the third, more in the hanging, goes under the name of the *Pipe-Stolln-vein*; to which may be added a fourth, further in the hanging, and called the *Rat-ground-vein*. All theſe veins are cut off to the ſouth by an oblique croſſing vein of red irony argillaceous ſlate, which is many fathoms thick. Beyond this red vein they have begun a gallery, unſucceſsfully driven already 278 fathoms length in black limeſtone, in hopes to reach again the copper-veins, if they ſhould be found continuing on the other ſide of this red vein. The vein is common ſhivery clay, different from the mountain by a ſmall mixture of mica. Often the ore is ſticking to quartz and gypſum. The ore commonly copper-pyrites, called here *gilf-ore*, containing no ſilver, but from eight to ten pounds of copper in a hundred. There is likewiſe grey copper pyrites, containing ſixteen or ſeventeen pounds of copper, and from three to ten ounces of ſilver. Accidentally they meet ſometimes with fine ſamples of white ore, *Cronſtedt.* §. 199, cryſtalline grey copper-glaſs, *Cuprum vitratum cryſtalliſatum cryſtallis decædris*

dris & planis tetraëdris, noble ſamples of verdegreaſe and copper azur, malachites, and white hair or capillaire vitriol, *Halotrichum Scopoli*, ſweating from or ſticking to the ſides of the works. This vitriol, which in undeterminate blue and green cryſtals is likewiſe produced on the timber, contributes greatly to its preſervation, ſince times immemorial no repair of timber has been wanting. The copper-ores at *Herrngrund* are auriferous. For this reaſon they ſeparate the gold-duſt in the waſh-mills. It would be impoſſible to ſeparate it to advantage by ſmelting and parting. The whole mine is divided into ſix fields, three to the ſouth and three to the north. In the northern fields the *Kugler*, the *Pipe Stolln*, and part of the *Herrngrund* veins are working; in the ſouthern they work only on the *Herrngrunder* vein. This vein is twelve fathoms wide. However, the different direction of the rocks, which it croſſes, affect it ſenſibly, either interrupting its run or forcing it into an other line of the compaſs. The ſame happens to the other veins. It has been conſtantly working theſe laſt five hundred years to a depth of 150 fathoms. The *Pipe-Stollner* vein is ſome fathoms thick; but the *Kugler* vein is only four feet. The cementing water is conducted by ſloping wood-canals, and many angulated windings in large wood reſervoirs. In the corners of theſe canals, and in the reſervoirs, they put old

iron, which precipitates the copper ſo ſucceſsfully, that the ſediments contain near ſeventy pounds of copper per hundred. The annual produce of this cementation does not however amount to above 5000 pounds. There is another profitable eſtabliſhment in the *Herrngrund* copper-works, a manufactory of verdegreaſe or mountain-green, *Viride montanum nativum*. To this purpoſe the mine-waters are conducted on old bing-places, which impregnate them with vitriol by the ſolution of the copper flakes ſprinkled in the deaf rocks. Thence they are led in ſeveral wood-reſervoirs, where running againſt obliquely erected planks the green precipitates as a ſediment. An hundred weight of this green ſells for 100 florins, and is to that rate delivered to the mineral ware- and ſale-houſe at *Vienna*.

The negligence of the ancients in ſeparating the ores has likewiſe in this place cauſed many bing-waſhings. Tho' there is a great number of them, they do not produce annually but about 300,000 pounds of clear copper.

Travelling from this place to *Moditſka* towards *Liptaw*, you ſee on both ſides of the way a chain of calcareous ſtalactite-like hills, above thirty fathoms high. Probably this ſtalactite has been carried hither by rain-water, from the limeſtone, ſuperincumbent on the *Carpathian* mountains.

I am

I am however at a loſs how to explain the figure of this cryſtalline limeſtone, which exactly reſembles that of ſtalactites, and appears often in globular and columnar forms of one or two feet thick.

Beyond *Moditſka* is a lead vein in limeſtone, worked without ſucceſs.

The iron works near *Rhoniz* and *Thaiſolz* belong likewiſe to the chamber at *Newſol*. At *Rhoniz* the iron-veins run in ſlate. The richeſt is on the *Sirk*, and produces ſome iron ſpar. I have not ſeen *Thaiſolz*. The hills about *Newſol* are calcareous and ſuperincumbent on argillaceous ſlate. But nearer to *Shemniz* the common rock is again metallic rock.

On the midſt of the way to *Shemniz*, where the highway to *Kremniz* and *Newſol* ſeparates, I obſerved near the bridge over the *Gran* ſome rocks of breccia, conſiſting of argillaceous and micaceous blunted ſtones, and reddiſh granite pebbles ferruminated by lime. Probably they have been carried hither from the *Carpathian* mountains and depoſited by the river in the before-mentioned rocks.

Near *Poinik*, an iron work under the chamber of *Newſol*, the iron vein runs in ſlate, and produces theſe fine iron ores, incruſtated with blueiſh diſtilled chalcedony, which you have taken notice of when you were in *Hungary*.

Konigſberg (Ui-Banya) in the *Borſher* diſtrict, is in rank the ſeventh of the free *Hungarian* mining towns. It is ſome miles to the north-weſt from *Shemniz*. The valley wherein it is ſituated conſiſts on one ſide towards *Shemniz* of metallic-rock, and on the other to the north of granite-hills, running hither from the *Carpathian* mountains. In the royal mine, at preſent working again, the vein runs between the red granite its hading, and between the metallic rock its hanging ſide. They call this granite mill-ſtone; ſince its feld-ſpath particles being diſſolved, and having left many holes, make it a good mill-ſtone. To this purpoſe it is exported to many parts of *Hungary*. The vein is grey quartz, mixed with auriferous pyrites. This place is remarkable on account of the firſt ſteam or fire-engine eſtabliſhed in the *Lower-Hungarian* mines, built here 1721 by *Iſaac Porter*, an *Engliſh* engineer in the imperial ſervice. Its object was the draining of the *Althandler* ſhaft; but, the works being given up nine years after, the engine has diſappeared of courſe.

Theſe are the notices which I have been able to take in reſpect of the *Lower Hungarian* mountains, veins and mines. If I ſhould recover my health next ſummer, I intend, in Mr. *Poda's* and *Scopoli*'s company, to make a trip in the *Carpathian* mountains; *Scopoli* to gather plants and

and inſects; *Poda* to make phyſical and mathematical experiments; and I for my part to have an eye to the nature of the mountains and the foſſils.

The deſcriptions of the metallic-mountains in the diſtrict of *Liptaw*, given by *Bel*, in *his Notitia Hungariæ*, and ſeveral curioſities which ſome ſtudents have brought me from the *Carpathian* mountains, prove to conviction that ſuch an excurſion will be an advantage for Natural Hiſtory. Were this part of ſcience better cultivated in *Hungary*, this kingdom might, I am confident, furniſh more remarkable obſervations, than perhaps any other in the World. But, alas! ſcarce the name of that ſcience is known hereabout, and I fear we may for a long while repeat with old *Seneca* to the lazy *Hungarians*: " *Sicut barbari ple-*
" *rumque incluſi & ignari machinarum ſegnes la-*
" *bores obſidentium ſpectant*, nec quo *illa pertineant*,
" *qua ex lonquinquo ſtruuntur*, *intellignnt*, *idem vobis*
" *evenit. Marcetis in rebus veſtris*, *neccogitatis!* "

LETTER

LETTER. XXI.

Shemniz, Sept. 13, 1770

YOU have ſeen by the ſeries of letters, which hitherto I have written to you, that the mountains in the *Bannat*, *Hungary* and *Tranſſylvania* conſiſt of granites, clay, lime, horn-and ſandſtone. But which are the moſt ancient? which are the richeſt? which in each of them is the rule of the veins and fiſſures? how have the different rocks ſucceeded each other? Theſe queries properly anſwered might furniſh a compleat theory of the *Hungarian* mountains.

The moſt ancient mountains in *Hungary* and its dependencies can only be obſerved in the higheſt mountains; and even there care is to be taken againſt the illuſion of the ſuperincumbent outſide. The *Carpathian* mountains, for example, might be conſidered at firſt ſight as calcareous mountains, if examined only in ſuch places where mines are working in ſlate and limeſtone; but that would prove as wrong as if a man was to fancy that hills covered with vegetable mould are thoroughly compoſed of it. Examining with this caution the *Carpathian* hills as far as the *Marmaros*, and thoſe which ſeparate the *Moldaw* from *Tranſſylvania*,

vania, and riſe near *Werſhez* in the Bannat, we conſtantly find that their undermoſt ſtrata, or rather their main-bulk and nucleus, conſiſts of granite.

I had ordered a young man, uſed to gather foſſils in the *Carpathian* mountains, to obſerve every rock appearing above the ſuperincumbent mountains, and to bring me ſamples from thoſe rocks as well as from the higheſt *Carpathian* ſummits. I had them, and it was grey granites. You remember the granite-chain running towards *Konigſberg*, which I mentioned in my laſt. I obſerved there, that the granites is in the hading, and argillaceous rock in the hanging ſide. Hence it appears that the argillaceous rock is accumulated and ſuperincumbent on the granites.

The granite rocks in the mountains behind *Alt-Sol*, running to *Upper-Hungary*, the ſame rocks which I mentioned at *Felſo-banya* and *Kapnik*, and run there underneath ſeveral ſuperincumbent ſtrata to the *Carpathian* mountains, prove to conviction that they conſiſt of granite. Look over my letters again from the Bannat. You will find noticed ſeveral places, in which the granite appears peeping from under the ſlate and limeſtone. Mr. *Delius*, in his Treatiſe on the Mountains, has likewiſe mentioned ſome ſuch rock; and theſe are granites, which includes the *Hazeg* valley, and ſeparates the *Moldow* from *Tranſſylvania*. It appears there either entirely naked, or covered with a ſlate

or

or limeſtone roof. All theſe facts together are fair evidence of the higher *Hungarian* hills conſiſting of granites. It is material to add, that there is no place in *Hungary* in which the granite appears to be naturally incumbent on other rocks; that wherever it appears above ground, the ſuperincumbent more modern ſtone ſtrata are eaſily to be diſtinguiſhed; and that granites has never been found in any mine to alternate ſtratified with other rocks. I know by the mineral-hiſtory of other countries that the ſame has been obſerved in general. However, I would not be underſtood as did I ſuppoſe the inner part of the globe to conſiſt of granite. It is rather probable that granite in ſuch depths, which hitherto we have not reached, and perhaps never ſhall, are accumulated on rocks of a ſimpler mixture. Nevertheleſs granite is the moſt ancient rock hitherto obſerved; and that opinion is greatly confirmed in *Hungary*.

To my knowledge there have not been hitherto found any metallic veins in the *Hungarian* granite-mountains. The *Althandler* vein at *Konigſberg* runs in the ſeparation between the granites and the metallic-rock. Perhaps after-times will lay open theſe hidden treaſures. That veins are running in other countries through the granite is a fact too obvious to want here to be evidenced by me.

The

The ſecond ſpecies of rock, which ſeems to have been produced after the granites is argillaceous, ſuch as hornſlate or argillaceous mica, thoroughly mixed with quartz. 2. *Kneiſs*, conſiſting of quartz, mica and lithomarga. 3. The metallic rock, being a hardened clay, mixed either with quartz or ſherl and ſpar or lithomarga. And laſtly, 4. trap and ſhivery clay.

Hornſlate is to my knowledge very ſcarce in *Hungary*; but you have ſeen by my letters, that the lead-veins near *Modern* in the county of *Preſburg*, on the foot of the *Carpathian* mountains, run in hornſlate: and at *Ruſkowa* in another lead-vein, under the chamber of *Shemniz*, likewiſe on the foot of the *Carpathian* mountains, the common rock is of the ſame kind: But theſe veins are leaping, thin and inconſiderable.

Kneiſs is on the ſole of *Simon Judas*, at *Dognazka* in the Bannat. Between *Saſka* and *Moldova* whole mountains conſiſt of it, but unobſerved to contain any copper-vein; and near *Shemniz* the *Kaiſerſtolln* in *Hodriz* is driven in *Kneiſs* for an auriferous quartz vein.

The moſt common and the moſt remarkable of theſe argillaceous rocks in *Hungary* is the metallic rock, which I have deſcribed before. Near *Konigſberg* we have found it immediately incumbent on granites. The large and conſtant gold and

ſilver

veins at *Shemniz* and *Kremniz*, as likewiſe the many rich veins at *Felſo-Banya*, *Kapnik*, *Nagy-Banya*, *Nagyag*, *Fuſes*, *Boitza* run in it. In the Bannat the conſtant copper-veins, nay even the richeſt mine at *Dognazka* are found in the ſame rock.

Our *trap*, which I have ſeen only in a ſingle mountain at *Kapnik*, contains but ſmall veins.

The *argillaceous ſlate* is the common rock at *Schmolniz*, *Newſohl*, *Tſhavoja* behind *Kremniz*, in the Bannat, and in the ſalt-works at *Torda*, *Marmaros* and *Sovar*. It contains commonly ſhort, thin and leaping copper-veins, running either acroſs or along this rock under incumbent limeſtone.

Limeſtone is the third, and if we do not take notice of the accidental beds, the moſt modern ſpecies of rock. In the Bannat it is conſtantly accumulated or depoſited on clay. In the *Oravitza* mountains ſome pretty conſtant copper-veins, and at *Saſka* and *Moldova* ſome ſhort copper-veins are working in it. In *Tranſſylvania* behind *Nagyag*, from *Darſha* to *Glut*, I found calcareous hills incumbent on argillaceous rocks, in which ſome poor copper-veins baſſetting out to the day were working. I do not remember to have heard of any metallic veins in the many high calcareous hills, which are ſuperincumbent on the granite-

hills

hills in the *Carpath* or thoſe which ſeparate the *Moldaw* from *Tranſſylvania*. From all theſe facts it follows, that veins between ſlate and limeſtone have conſtantly a hading of ſlate and a hanging ſide of limeſtone. I am really of this opinion, though I have had many objections againſt it, when in the Bannat I found ſome mines with a hanging of ſlate and a hading of limeſtone; but on nearer examination theſe my ſcruples diſappeared for very good reaſons, which I will ſpeak of in the deſcription of the accidental rocks. Here I am obliged to take notice, that lime is very often immediately incumbent on granite. Thus I have been told, at leaſt by many people who have ſeen the *Carpathian* hills, and may be very well accounted for by ſuppoſing granite rocks uncovered by argillaceous rocks when the limeſtone beds were produced.

Thus far of the three ancient ſpecies of rocks, known in *Hungary*. Though it be impoſſible to determine whether they have been produced within a ſhort ſpace of time, or whether they have been accumulated in a long ſucceſſion of many ages, I am rather inclined to the firſt opinion. I have ſeen granite, whoſe ſurface, where it was in immediate contact with the incumbent clay, was entirely changed into clay; nay I keep in my cabinet ſome pieces of granite, with incloſed

fragments

fragments of ſlate. I have ſeen argillaceous mountains, and noticed them in my letters from the Bannat, which by the ſuperincumbent lime were penetrated and changed into marle. Might not theſe facts incline us to believe, that the granite and clay-beds were ſtill in a ſtate of a wet paſte, when the ſuperior beds were accumulated and depoſited upon them? and that accordingly the origin of theſe different rocks cannot be greatly diſtant in reſpect to time? But I go aſtray in hypotheſes which in this place are to no purpoſe. It is a great ſatisfaction to me, that my obſervations on the origin of the rocks agree with thoſe of the beſt naturaliſts. Being eſtabliſhed on experiments and facts, which I have ſeen myſelf, I am under no apprehenſion, that my ſyſtem can poſſibly be conſidered as an adopted opinion, or what is ſtill worſe, as a fancy hatched in my ſtudy. Baron *Haller* has given in the preface to his Deſcription of the *Helvetia*, a fine account of the *Alps* in *Switzerland*. He is very explicit that the higheſt tops of the *Alps* conſiſt of a rock, which is compoſed of glimmer, quartz and a looſer ſtuff, probably feldſpath, is of a granite-ſpecies, and goes in *Switzerland* under the name of *Gieſbergerſtein*. The common *Alpine* rocks are a ſpecies of ſlate; and the lower hills are covered with limeſtone, ſome ſorts of marble,

marble, and other hard rocks. The ſame is confirmed by Mr. *Gruner*, in his account of the ice-mountains of *Switzerland*. Lord *Bute* has noticed the ſame rule in the *Pyrenean* mountains, and communicated that obſervation to Baron *Haller*. The *Tyrolian* mountains are granite covered with ſlate, as I ſee by a collection of foſſils, which Baron *Adolph Meyer* has brought me from that country. The ſame is obſerved in the *Bohemian* mountains. When I lived at my country ſeat *Altzedliz*, on the high mountains which ſeparate *Bohemia* from the *Upper Palatinate*, I examined theſe hills with attention. The whole chain of mountains, which from *Bavaria* runs to the circle of *Eger*, is granite, in ſeveral places covered by hornſlate and other argillaceous rocks. Near *Eger* and *Mautdorf*, towards the *Palatinate*, on the ſloping of theſe mountains the firſt limeſtone-hills occur to the obſerver. Baron *Pabſt von Ohain* at *Freyberg*, and Meſſrs *Charpentier* and *Lommer*, profeſſors in the miner-academy at *Freyberg*, have made ſeveral excurſions and obſervations to the ſame purpoſe in the *Harz* and *Saxonian* mountains; and the *Swediſh* are of the ſame nature according to your obſervations and thoſe of Baron *Linneus*. It is to be hoped that naturaliſts, ſkilled in mineralogy, will henceforth examine this opinion wherever they ſhould happen

to have an opportunity to do it; in order to bring it to ſyſtematical evidence, as highly intereſting to philoſophers and miners.

But let us return to the *Hungarian* mountains, and examine their accidental rocks. Such are in my opinion ſome limeſtone hills, the ſandſtones and ſome ſlate-ſtrata.

It is a hard taſk to determine, which limeſtone is more ancient, and which accidental. The greateſt mineralogiſts aſcribe the origin of lime-ſtone to a deſtruction of marine ſhell-fiſhes. But is it poſſible that thoſe immenſe maſſes of lime-ſtone ſhould be owing to the animal kingdom? A great part of the *Carpathian* mountains, the bordering hills of the *Moldaw* and *Tranſſylvania*, the mountains in *Steyermarck*, and a great many more to my knowledge are almoſt entirely covered and buried under limeſtone. What immenſe quantities of ſhells would not be requiſite to the origin of theſe limeſtone-hills? *Cronſtedt* has obſerved already, that the granulated and ſcaly limeſtone is deſtitute of petrifactions. Are we by that intitled to rank theſe ſpecies under the ancient calcareous rocks, and thoſe with petrifactions to the accidental ones, produced by more modern inundations? I ſhall leave that entirely to the determination of thoſe learned men, who have more principles and obſervations than I have acquired

quired myſelf. But it is fact, that in *Hungary* hitherto no metallic veins have been diſcovered in rocks filled with petrifactions. I rank however the ſtalactite-like limeſtone beyond *Altgeburg* and *Newſohl* under the accidental limeſtone. In the ſame claſs I rank the ſandſtone, which in *Hungary* ſurrounds the nobler metallic mountains, as near *Nagyag* and *Facebay* in *Tranſſylvania*. Sometimes they appear in inſulated hills; and often they are accumulated on calcareous ground. In theſe ſandrocks there has not been hitherto found any conſtant or metallic vein. The *accidental* ſlate is often accumulated on this ſandſtone, on lime and other ground. It is produced as the ſtalactite-like limeſtone by rain or other water, which waſhed and carried together the diſſolved particles of the more ancient mountains. Thus it covers, for example, the coal-beds between *Kremniz* and *Shemniz*, near *Roniz* and near *Waizen*. By the ſame reaſon it appears as the hanging ſide in ſome mines of the Bannat of *Temeſwar*. I ſaw at *Saſka* a mine whoſe hading was limeſtone, and whoſe hanging was ſlate. The copper-vein was in the limeſtone. The old hanging ſide, if there was any before, ſeems to have been carried away by accident; and then the diſſolved parts of the higher argillaceous hills, which I mentioned in my journey from *Saſka* to *Moldova*, have been

carried there and compoſed the preſent hanging. The red ſlate at *Nagyag*, near *Boicza*, and near *Zalathna* in *Tranſſylvania*, ſeems to have had a ſimilar origin.

As indurated clay is not ſo eaſily diſſolved by water as limeſtone, this ſlate never occurs in large beds or in conſiderable hills. The mixture of diſſolved limeſtone and argillaceous parts has probably produced the marle, which in reſpect to its œconomical uſes is entirely neglected in *Hungary*.

It is certainly matter of ſurprize to you, that hitherto I have not mentioned the hornſtone: Petroſilex: But I freely confeſs I am at a loſs where to rank it, whether among the old or the accidental rocks. In my letter from *Zalathna* I deſcribed the mountains at *Facebay*, eſpecially the *Loretto*-mine. This rich gold-mine is working in hornſtone, incumbent on argillaceous beds; but it clearly appears to be produced by modern inundations, as you will remember from the letter to which I referr you. The petrifactions in the white hornſtone near *Lehotka* prove that this ſpecies of rock belongs to the accidental ones. I cannot conſider the horn and flint-ſtones as produced by the gelatinous ſubſtance of marine inſects; a fancy which once a good naturaliſt has in confidence entruſted me with, but I rank it

next

next to the current hypotheſis, of limeſtone being the remaining ſubſtance of deſtroyed and diſſolved ſea-ſhells.

The veins in theſe hornſtone-mountains are more conſtant and richer than thoſe between argillaceous ſlate and limeſtone. Thoſe at leaſt, which I deſcribed to you in my letters, contain gold and ſilver-ore. If this rock ſhould belong to the more ancient ones, which I leave to your determination, it muſt have been produced at the ſame time as the calcareous ſtrata were produced, ſince I find it never incumbent on lime but conſtantly on clay. Perhaps future obſervations will prove ſome ſpecies of hornſtone, like ſome ſpecies of clay, ſlate and lime belong either to the ancient or to the accidental rocks.

All theſe primogenial and accidental mountains and rocks owe their origin to water; and have been produced, either when the world was raiſed from the chaos, or according to Mr. *Linneus's* opinion, when the whole earth was covered with water, and the precipitation, cryſtalliſation and diſſolution of ſo many animal and vegetable ſubſtances brought forth ſo many new ſtratifications; or finally they aroſe from later inundations.

I ſhould here mention thoſe mountains that are produced by fire. There are actually ſome marks of ſuch mountains in *Hungary*. The vitre-

ous black lava, *pumex vitreus Linnæi*, at *Tokay* in *Hungary*, and ſeveral ſorts of lavas from the *Carpathian* mountains, give conjectures and evidences of that kind. But to be particular on that account, I want to examine the whole chain of the *Carpathian* hills, which I have a mind to do next year if my impaired health puts no ſtop to theſe my intentions.

LETTER

LETTER XXII.

Shemniz, Sept. 28, 1770.

BY the laſt poſt I received an order from the court, to accept of the vacant commiſſion of Count *Colloredo* in the board of mines at *Prague*. I do not know whether I ſhall rejoice at it or not. It is out of my power to viſit the *Carpathian* mountains; however I am to follow where deſtiny calls me to no unprofitable ſituation, and I am preparing for my journey to *Prague*. Though I have but a few moments to ſpare, I give, according to your deſire, an account of the different ores found in the *Lower Hungarian* mines.

Native gold is very ſcarce in the royal mines at *Shemniz*, though in general the ores are auriferous, being for that very reaſon pulveriſed and waſhed. In the beginning however of January laſt, they have found in *Emperor Franciſci Stoln*, in the field of *Siegelſberg*, and in a ſoaring fiſſure, which runs towards the great *Bieberſtollner* vein, a lump of ſound red ſilver ore, mixed with glaſs ore, and

covered with ſome native gold. A hundred weight of this ore contained about 1270 ounces of ſilver. In the private mines the native gold is more obvious; it appears in a capillary form on quartz, in ſoft and brittle glaſs ore on the *Hofer* and *Antony de Padua* mine. So it is found likewiſe on red ſilver ore. At *Kremniz* and *Konigſberg* it is ſtill more common. At *Kremniz* it is often found in lamellœ. I have likewiſe a fragment of irony quartz with native gold from *Ladiſlai-Stolln* at *Bugganz*. The *Lower Hungarian* gold is in general to be cleared from auriferous waſh-ores or from zinnopel, which is a mixed red jaſper, containing gold, ſilver, lead, zinc, and pyrites. It is the common rock of the *ſpital* vein, and in general ſtrikes fire with ſteel, though there are ſome looſer ſpecies of this zinnopel, which taint the fingers and look like red bole. Perhaps its conſtituent parts will prove it to be of the bolus kind; the looſer ſpecies appears often in a globular ſcaly form like button ore ſtriking on harder zinnopel: If found ſtratified in waſh-ores, conſiſting of blende, lead, and a blueiſh clay, it goes under the name of *ſtring zinnopel*, *(ſchnur zinnopel)*. Mr. *Scopoli* is at preſent about a laborious chemical analyſis of the zinnopel,

zinnopel, which he intends to publiſh in his *Anni hiſtorico-naturales*.

I can form no idea of the yellow zinnopel, mentioned by Mr. *Cronſtedt*, unleſs he means to give that name to irony jaſper. If that ſhould be the caſe, we might as well give the ſame denomination to the red jaſper, which is ſo common in the *Calvariberg* and the *Pacherſtolner* vein where it is rejected as rubbiſh. The denomination of zinnopel implies an auriferous quality.

Another ſpecies of auriferous ſtamp or waſh-ores is the irony quartz found at *Bugganz*, and in the *Kaiſerſtoln* at *Hodriz*. You remember perhaps a paſſage in the account of mining works publiſhed at *Freiberg*, in which is conjectured, that irony quartz is generally auriferous; our ſtamp ores ſeem to confirm it.

The pyrites, ſeparated from the lead and blende by pounding and waſhing, contains likewiſe a great deal of gold. A hundred weight of this pyrites yields fifty-four pounds of ſtone or lech, and three denarii of ſilver, which per mark contains fifty denarii of gold. The pyrites at *Konigſberg* and *Kremniz* are ſtill richer. Pyrites containing ſilver, go here under the name of *Gelft*.

Native ſilver is ſtill more uncommon in the *Lower Hungarian* mines; all the while I have been here I have got but two ſamples, one from *Old Anthony*

Anthony de Padua Stoln and the other from *Thereſia-Shaft.*

On the firſt the native ſilver appears in long and thin threads, like human hair, ſticking on quartz. The ſecond is a pale yellowiſh pyrites, from which the ſilver ſeems to be grown; this is the more precious for me as *Henkel*, if I am not miſtaken, denies native ſilver to be ever found on pyrites. We are the better furniſhed with other ſcarce ſilver ore.

Glaſs ore cryſtallized extremely ſcarce. The miners call it here *Weich-Gewaechs* or ſoft ore, in order to diſtinguiſh it from the brittle glaſs ore. You have ſeen in my cabinet glaſs ore in cubical forms from *Siegelſberg*, and another knotty ſpecies from *Moderſtoln.*

Glaſs ore, brittle, called here *Roeſh-Gewaechs*, is ſilver mineralized with more ſulphur. It contains from four to five hundred ounces of ſilver per hundred; often its value is but ſeventy or eighty ounces. Its deſcription in *Juſti's chemical works* is exaggerated and extravagant. *Scopoli* will probably give a better account of its conſtituent parts.

Red ſilver ore is found at *Shemniz* and *Kremniz* either ſound or cryſtalized. That found at *Kremniz* is auriferous. On *Old Anthony de Padua Stoln* near *Shemniz*, I have met with dendritical red

red ſilver ore on white quartz; and on *Rudaina Anna Stoln*, between *Konigſberg* and *Shemniz*, I found it light coloured and ſticking in pyrites. Dr. *Moller*, at *Newſohl*, has in his cabinet dark red ſilver ore in globular forms. *Scopoli* is likewiſe analyzing this ſort of ore.

White ſilver ore is very common at *Kremniz*. It is auriferous, and commonly as it were an incruſtation of white quartz. The miners at *Kremniz* call this incruſtation *Blachman*; but thoſe at *Shemniz* give this name to the pyritical incruſtations of glaſs ores or rocks, and it is conſtantly obſerved near the richer ores.

Grey plumoſe ſilver ore, from *Old Anthony de Padua Stoln*, different from the *Saxonian* ſpecies by its being caſt in white quartz, not in capillary cryſtals but in ſtar-like ſpots. There is a large vein of this ore. It takes a good poliſh, which pretty well ſets off its ſtar-like form, and the ſilver ſprinkled in antimony.

White plumoſe ſilver ore. I am of opinion, that this ſpecies is no where elſe to be found. Some years ago it was very plenty in *Old Allerheiligen* mine at *Hodriz*. Its white cryſtals reſemble the white cryſtalline pin-like horn ore, and ſtick in a matrix of irony quarts.

Gooſe dung ore, of the ſame form as deſcribed by *Wallerius*, *Spec.* 301, No. I. of a yellowiſh,

yellowiſh, green, and reddiſh colour, was dug in conſiderable quantity at *Windiſh-Leuten* near *Shemniz*; one hundred weight yielding only 800 ounces of ſilver.

Silver ocher, of a browniſh, yellow, and white colour found in the ſame place; containing from three, ſix, to fifty, and one hundred ounces of ſilver; the native ſilver often viſible in it.

Field-ſpath, containing ſilver; of a yellow, red or white colour and hard contexture. Roaſted in fire its colour changes to brown and black; but then the ſprinkled quartz particles appear to ſight unchanged in their colour. It contains from four to eight ounces of ſilver; is found concomitant with richer-ores on *Siegelſberg*, *Chriſtina-ſhaft*, and other private mines. *Brunnich*, in his ſupplements to *Cronſtedt's Mineralogy*, §. 35. has noticed already the blue colour, which appears on ſome ſpecies of ſpar in *New Anthony de Padua Stolln*, and conſtantly indicate a richer ſilver value.

Blende, containing ſilver. I do not know the globular ore, which *Cronſtedt* mentions, §. 175. However, ſuch a ſpecies of blend may have been found in former times, which were remarkably negligent of ſuch curioſities. Nevertheleſs it is fact, that our blende conſtantly contains ſome ſilver though in a ſcanty quantity; and for this very reaſon, it is never thrown away among the

the rubbiſh, but ſtampt like other ores. It is commonly brown, ſolid and of a ſcaly contexture; however, I have found here knotty, black, yellow, green, ſemipellucid, whitiſh and ſeveral cryſtalline ſpecies of blende.

Lead ore, contains ſilver, and is commonly of a granulated or lamellous contexture. However, there are likewiſe ſeveral ſorts of cryſtalline ore. White and grey lead-ſpar is found at *Windiſh-Leuten* in the above ſilver-ocher. Blue lead ſpar found in the ſame place.

Copper-ore is found with other metals in the *Spitaler-vein*, but the greateſt plenty in *Herrngrund* near *Newſohl*. It conſiſts of yellow and grey copper-pyrites, fallow-ore, and copper-green.

Iron-ore is digging near *Roniz*, *Thaiſolz*, and *Libeten*. Commonly it is yellow and blue hæmatites (*Cronſtedt*, §. 203.) Black button-ore is conſidered as ſomething rare. Such is the dripped ore from *Boinik*, in the ſurface covered with points or pins two inches long, each of them incruſtated with blue chalcedony.

Quickſilver never occurs in a native ſtate; but cinnabar-ores appear now and then, though in no ſuch plenty as to deſerve parting. If found concomitant to richer ores, they contain ſome denarii of gold. During my ſtay in this place they have

have been found on *Siegelſberg*, on the *Windſhaft* and on *John's Kluft*, commonly in white looſe clay.

Antimony was found laſt year in *Three-Kings Stolln* on white quartz, formed like ſtars. It is however ſcarce in the *Shemniz-mines*. But at *Kremniz*, in the *Rothiſh-mine*, noble ſamples of cryſtallized antimony are dug out. Sound antimony with native gold, though ſcarce, found at *Magurka*. Red antimony ſaid to have been found in former times on *Althandle* at *Konigſberg*. The ſcarce antimony ſamples, I am poſſeſſed of, are found at *Konigſberg*. One conſiſts of fiſtulous antimony covered with a red incruſtation; the other conſiſts of accumulated antimony-cryſtals, each covered by an incruſtation of white quartz. *Cronſtedt* mentions a ſimilar ſpecies.

Arſenic never offers in the *Lower-Hungarian* mines in its ſemi-metallic or calcareous form: For this reaſon our miners are leſs ſubject to diſeaſes than thoſe in *Bohemia*, *Saxony*, and the *Upper-Harz*. There has been however found between *Kremniz* and *Newſohl*, in a bed of grey ſandſtone, red arſenic of a fibrous texture.

Sulphur is found mineralized as pyrites in many different forms, as capillary, globular, undulated, dripped and cryſtalline. I have mentioned the

the orpiment of *Thajova* in one of my former letters.

Vitriol drips into ſtalactite-like forms in the *Pacherſtoln*. There is plenty of it every where in the *Old-man*, the roof and the drifts. Its colour white, green, yellow and brown. At *Herrngrund* near *Newſohl* it appears often in blue and roſy-coloured ſtalactites; the laſt ſpecies now and then mixed light blue. It generally contains within ſome moveable water-drops.

Halotrichum Scopoli, or the hair-ſalt, ſeems to me to be vitriol. I do not ſee that it is materially different from vitriol. It bloſſoms on the ſides of the galleries at *Shemniz*, *Kremniz* and *Newſohl*.

I have no time to ſpare for a deſcription of the many different ſtones and earths, which I have collected here. I am poſſeſſed of an innumerable variety of quartz and ſpar-cryſtalliſations; which you ſhall find deſcribed in the catalogue of my foſſils, intended for print as ſoon as I ſhall be ſettled at *Prague*.

My next from *Vienna* will tell you what hope of recovery is left me, and what curioſities deſerving your attention I have met with.

LETTER

LETTER XXIII.

Vienna, Oct. 19, 1770.

YOU are acquainted with the diverſions, advantages and diſadvantages of this city, and the ſtate of learning in this capital univerſity has not eſcaped your obſervation. You complained in one of your letters, that, among ſo many expenſive eſtabliſhments for the ſciences, a profeſſion and a collection of Natural-Hiſtory has been moſt unaccountably forgotten. If among thoſe, who are intruſted with the reformation and improvement of the ſciences, a ſingle friend or connoiſſeur had hinted it, her majeſty would not have neglected it, as her royal care and munificence has amply exerted itſelf in ſo many ornaments and improvements of the univerſity. Unluckily *Van Swieten* is neither a remarkable friend nor connoiſſeur of Natural Hiſtory; a deficiency eaſily to be pardoned in a man, who is ſo eminent in many other parts of learning.

With your obſervations in hand I examined the imperial cabinet of foſſils. You have ſcarce left me any new diſcovery. However, you have over-

over-looked a great fragment of black vitreous lava found in *Hungary*. It is thrown in a corner, as deserving no great attention. They are the more particular and forward with their pretended gold-grains inclosed in raisins, with their gold incircled vines, and the gold threads, supposed to have grown as plants. But all these rarities are downright impostures. Yellow resinous sap is looked upon as gold-grains, and the pretended vegetable gold threads appear to an unprejudiced eye, what really they are, artificial gold-wires. I will allow that they have been found twisted around the vines; but might not these remains of ancient *Hungarian* dress and magnificence have been hid in the ground, by accident have been torn up with the vines, and by error have been considered as vegetable productions? This is the more forcible, because these vegetable gold rarities are generally found near *Tokay* and *Altsohl*, places renowned in history for having been residencies of *Hungarian* princes and kings, and equally known for many battles fought in that neighbourhood. Even the *Hungarians* of the present age delight in saddles, harnesses, swords, and weapons, ornamented with massy gold thread.

The collection of fine and precious stones is really admirable. I was remarkably pleased by

the diamonds, half white and half red, or half yellow and white.

Though it is impoſſible to form an exact idea of the whole by a ſight of a couple of hours, I did not however find here either the compleat varieties of minerals, nor the inſenſible gradations of varieties of different ſtones, nor any of thoſe mineralogical ſingularities which diſtinguiſh even at firſt ſight the cabinets of a connoiſſeur from thoſe of mere collectors. So I miſſed likewiſe the greater part of the ſcarce minerals of the imperial ſtates.

Mr. *Jaquin* has gathered in *Hungary* a fine cabinet of foſſils. Have you ſeen his native gold in molybdæna from *Rhimazombat* between *Newſohl* and *Schmolniz*? The botanical garden under his inſpection is likely to be very ſoon the firſt in *Europe*.

The collection of the *Minories* reſembles rather to a raree ſhow than to a cabinet of natural curioſities. I go very often to Baron *Moll*. His choſen collection of minerals, which is ſo remarkably rich in fine petrifactions, and his explications, give me both inſtruction and entertainment. Pity it were if this fine collection ſhould be ſeparated ſome ſome day or other; but this ſeems to be the fate, ſince his ſons have no inclination for this part of ſcience.

The

The collections in the academies for noblemen have afforded me great delight, not indeed by their rarities, but by their inspiring young noblemen with some relish of this science. Every noblemen in the *Theresian* college has a small cabinet of minerals, shells and insects in his apartment; and *P. Shiffermuller* spreads his taste for Natural History among these young people with great success, and very good hopes for aftertimes. This learned man is to publish the butterflies of *Austria*. The *Piarists* in the academy of *Savoye* and *Læwenburg* have of late established Professors of Mineralogy, and they think seriously of encreasing their collections.

At *Prague*, I shall be almost entirely destitute of literay company. Mr. *Peithner* is the only man, by whose science I may improve my knowledge. It is unhappy that we are doomed to live in so distant countries. If I were so free as you, my impaired health should put no stop to a trip to *Carlscrona*.

THE END.

ABSTRACT

OF

MR. J. J. FERBER'S

MINERALOGICAL HISTORY

OF

BOHEMIA.

Published in GERMAN at BERLIN, 1774

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Catharinaberg, *in the Circle of* Saaz.

THE mountains about *Catharinaberg* conſiſt of gneiſs, which is a mixture of quartz, mica, and white or reddiſh half petrified clay. This clay has been by ſome mineralogiſts conſidered as lithomarga; but it is commonly deſtitute of its qualities as deſcribed in *Cronſtedt's Mineralogy*, §. 78. It is rather common clay. *Terra porcellana phlogiſto aliiſque heterogeneis minima portione mixta. Cronſtedt*, §. 78. 2.

Between *Catharinaberg* and *Grunthal* detached columnar baſaltes, common on the highway, tumbled from the adjacent hills, in which it ſeems to be incumbent on gneiſs. *

* Between *Lowoſiz* and *Topliz* the mountains conſiſt generally of granites, in which red feldſpath is predominant. It is ſtriped and undulated with blackiſh glimmer. Columnar baſaltes ſtands on ſome of theſe granite-hills. I have ſeen thereabout baſalt-rock, deſtitute of regular priſms, but conſiſting in a large maſs, cracked and ſplit in many pieces, more or leſs angulated, and containing plenty of black ſherl cryſtals.

The gneiſs-mountains at *Catharinaberg* are continuations of the metallic mountains at *Freiberg* in *Saxony*, which conſiſt of the ſame rock. They run towards the *Saxonian* upper metallic-mountains, and inſenſibly degenerate into argillaceous ſlate, as may be ſeen even at *Marienburg*. On the *Bohemian* ſide the ſame degeneration of gneiſs is to be obſerved in the further run of the mountains; but it continues here longer in an unaltered ſtate as far as *Joachimſthal*, where the veins are found in argillaceous ſlate, and even that extremely micaceous wherever it baſſets out.

For theſe reaſons, and in reſpect of its ſituation and extent, gneiſs is to be conſidered as a variety of argillaceous ſlate; and in reſpect of its mixture it might, with as much probability, be conſidered as a variety of granites, inſtead of feldſpath mixed with clay.

No body will diſapprove of theſe aſſertions, as chemical and other obſervations have proved that mica *(glimmer)* is produced by clay, and reſolves again into the ſame ſubſtance; that part of the ſubſtantial earth of clay is flinty; that clay changes into quartz and other flinty ſtones, which by art can be reduced again to clay in an aluminous form; and finally, that quartz and feldſpath, by the action of air and age, diſſolve into a white clay,

clay, for which reaſon many granites contain this white clay in the place of quartz and feldſpath. If this clay ſhould not be conſidered as diſſolved quartz or feldſpath, but rather as their original earth (as now and then ſeems to be the caſe) it makes no material difference. However, the diſſolution is here more probable, ſince in the circle of *Pilſen* in *Bohemia* many hills of granite, of pure argillaceous ſlate, of grey micaceous gneiſs-ſlate, and of hornſlate, are obſerved to be affected by the air; ſo that their outſide, for two or three feet, is changed into a white and clayiſh ſubſtance, which, in the granites, ſcarce offers any viſible mark of their former conſtituent parts of quartz, mica, and feldſpath; nay often they looſe their very hardneſs and ſtony concretion, ſo as to appear diſſolved and mouldered into a white, looſe and ſoft clay, in which but a few mouldering quartz- and feldſpath grains, with ſome mica lamellæ, are to be diſtinguiſhed; the latter changed from their black and gloſſy brightneſs into a pale ſilver-colour. Few of theſe ſtony granite-particles are viſibly remaining in this clay; there are however enough to prove its being a ſolution of granites, which is the more eaſily to be granted as granite in itſelf is compoſed of argillaceous ſub-

ſubſtances. ‡ Similar argillaceous ſolutions of the pure, micaceous and gneiſſy clay-ſlate are very common in the circle of *Pilſen*. This white clay is dug for example near the new inn in the neighbourhood of *Oſtraw*, near *Innichaw* and in ſeveral other places; and it is made uſe of in common

‡ Having in the year 1753 viſited and examined the *Blockſberg*, which is the higheſt mountain in the *Harz foreſt* and in *Germany*, I found it in its whole extent and wide ſpreading ramifications, conſiſting of grey granite. Where this rock riſes above the metallic ſlate of the *Harz-mountains*, it appears, either entirely naked, or more or leſs covered with ſwampy combuſtible ſlaw turf, produced by rotten vegetables. On the very higheſt ſummits of this famous mountain and on its wide branches, ſuch as the *Little Blockſberg*, the *Heinrichſhohe*, the *Bruchberg*, the *Renneken-Stein*, and many more, the granite appears in immenſe ſhattered maſſes, confuſedly piled up—Vaſt ruins of a former world. In the deeper valleys it appears ſound and ſtratified. The air has viſibly affected its hard ſubſtance, in changing the colour of its outſide, in leſſening its hardneſs, where moſt expoſed to the inclemencies of the weather, nay, in diſſolving it into more or leſs coarſe ſand and clay. Large beds of this *granite-ſand* have been waſhed down in the valleys, on the ſlope of theſe mountains, and to the foot of the moſt expoſed mouldering rocks; nor is there want of *granite-clay*. As the mica in theſe granite decays is often of a yellow braſs or white ſilver-colour, times immemorial theſe decays have been conſidered by the inhabitants of theſe wilderneſſes as gold-and ſilver-ores. The colour of theſe ſands and clays, or pretended ores, differs according to their different ſolution,

mon pottery, nay, on account of its white colour, it is employed as lime in the waſhing, whitening and incruſtating of houſes and walls. If this clay be found in ſuch beds, as baſſet out or are expoſed to the day water, then it is commonly mixed with heterogeneous matters, and its colour is accord-

ſolution, mixture and poſition, as Mr. *Ferber* has very juſtly obſerved. I found on the higheſt ſummit of the *Blockſberg*, near a rock, which is called the *Devil's-Chancel*, a fine pale yellowiſh clay, and a reddiſh ſpecies in another place, which imparted to the hands, when rubbed with it, a fine ſilver-or gold-glittering. This viſibly derives from the fine ſolution of the mica, and, together with the remarkable ſaponaceous ſoftneſs of the clay, forcibly cauſes me to ſay ſomething of the finer *China-clay*, as having the ſame qualities. 1. I know that a very fine and white ſpecies of *China-clay* has been diſcovered of late in a vein, which croſſes the granites in the *Bruchberg*, connected with the *Blockſberg*. I know, 2. that the *Petuntſe* of the *Chineſe* is a more or leſs decayed granites. And 3. that the *Kaolin* of the *Chineſe* has been conſidered by many as the ſubſtantial earth of granites. Therefore I ſhould be inclined, and think myſelf intitled to conclude, "that *China-clay* is but a fine ſolution of decayed granite; that there is "a good chance to find *China-clay* in or near any granite "mountains; nay, that perhaps ſuch a clay may be produced "by proper artificial decompoſitions of the granites."

Whether the quartz or other fine ſand, which covers ſo large and extenſive parts of the world, and of the ſea-ground, may be aſcribed to diſſolved granite-mountains or not? is a queſtion which I cannot paſs ſilent. The many detached granite-

accordingly browniſh or yellowiſh. Sometimes theſe colours may be owing to a ſtronger irony-mixture of the rock, or to the yellow browniſh clay-ſlate, which is not uncommon in theſe parts. Theſe ſorts of clay, the white as well as the yellow, turn red in fire, the white leſs than the yellow, which evidences its being leſs impregnated with iron than the latter. The yellow clay is uſed as common loam in walls. In a great part of the circle of *Pilſen*, and on the frontier mountains towards the *Upper Palatinate* and *Bavaria*, the vegetable mould, or the upper ſtrata of the ground, are extremely loamy. Unleſs they be accumulated by river-inundations, they may be properly conſidered as produced by ſolutions and decays of the adjacent granite and other argillaceous hills, which will, I am confident,

granite-pebbles and rocks, which are ſo frequent in theſe ſandy plains, ſeem to favour ſuch an opinion; and as among the pebbles of the ſea-ſhores, beſides theſe granite-pieces, a great variety of the harder remains of the more ancient mountains, nay of different ſecundary ones, are to be found, ſuch as jaſper, porphyry, various coloured hornſtone, quartz-lumps, gneiſs, hornſlate, marble, limeſtones and flint, which prove that nothing ſtands proof of age and time; this opinion gains ſome credit, and this the more ſo, as hitherto no ſort of rock has been diſcovered, in which a greater quantity of viſible quartz be contained. The pure paraſitical quartz, depoſited in the veins, would prove, I think, inſufficient to cover half the world with ſandy plains. (Tranſl.)

account

account likewiſe for the ſimilar nature of other countries.

In thoſe places where the granites is not entirely diſſolved into clay, but mouldered only to pieces, a browniſh ſand is produced, ſimilar to that which occurs on many ſhores, and which is perhaps owing to the ſame cauſes.

But now the queſtion ariſes, how nature operates theſe argillaceous ſolutions of the rocks? No body indeed will queſtion the co-operation of the air and the long ſeries of ages; but how acts the air? If I was allowed to recur to the general acid of the air, I ſhould have done very eaſily with my explication, ſince I have ſeen the ſulphurous acid in *Italy*, iſſuing from the old volcanos, change even the black and vitreous lavas into a white and aluminous clay. But the vitriolic acid in the air begins of late to be controverted, unleſs vitriol-works and other vitriolic exhalations account for its preſence. However, I cannot help obſerving the ſimilarity of theſe ſolutions of lavas, and ſuch rocks as contain quartz and feldſpath; and accordingly I am of opinion, that nature operates them in the ſame manner. It is fact and experience that air ſoftens any rock whatever; why or how? that I leave to future examinations. But as the rocks, I am ſpeaking of, turn to white clay, it ſeems to me owing to the acid of their own argillaceous mixture, ſince by Mr. *Beaume*'s excellent

excellent Treatiſe on Clay it appears, that clay conſiſts of vitriolic acid, connected with flinty or vitreous earth, and according to Mr. *Poerner*'s annotation, with ſome phlogiſton. Now ſuppoſing theſe rocks or ſtones to be ſucceſſively ſoftened or looſened, and the acid of their ſubſtantial mixture by humidity or other cauſes to be ſet in motion; the ſame phænomenon ought to ariſe, which the acid ſteams produce in the lavas. Vitriolic pyrites, after having undergone ſeveral elixiviations, continues to produce vitriol, when expoſed for ſome time to the air. The reaſon is, not, what the ancient chemiſts ſuppoſed, that it attracts new acid from the air, but that its own ſtill fixed and unactuated acid is by the air ſet at liberty, in motion and in activity, to ſeparate from the phlogiſton, and to corrode the metallic earth. This phænomenon is called the *mouldering* (*verwitterung*) of the pyrites; and the ſimilar alteration of the above rocks goes juſtly under the ſame name. Their acid forſakes the phlogiſton or other mixtures, which fixed it; it ſpreads now in the looſened ſtone, acts upon the vitreous earth, unites with this earth and produces clay.

But I have deviated too much from my ſubject, and return therefore to the gneiſs-mountains at *Catharinaberg*. I ſaid that they are to be conſidered

conſidered as continuations of the *Freiberg* gneiſs-mountains, and of the *Saxonian* and *Bohemian* argillaceous ſlate-mountains; or, which is the ſame, that the whole tract of the *Bohemian* and *Saxonian* mountains, which conſiſts of gneiſs and clay-ſlate, is the ſame ſtratum. Beſides I have endeavoured to ſhew, that the difference of clay, ſlate and gneiſs is not againſt this aſſertion, ſince their conſtituent parts are ſubſtantially and really the ſame; and that the ſame ſubſtantial earth, which in the upper metallic mountains produced clay-ſlate, has under other accidental circumſtances and mixtures produced gneiſs in the lower metallic mountains at *Freiberg* for example, and at *Catharinaberg*.

This gneiſs and argillaceous ſlate is in *Bohemia* and *Saxony*, as in many other countries, incumbent and accumulated on granites, and is in ſeveral places covered with limeſtone; which fully confirms the obſervation, that the prevailing and general rock-ſtrata in the greater and higher *European* chains of mountains conſiſt of three different ſorts of ſtones. The loweſt and undermoſt and moſt ancient, which in the higheſt tops appears bare and naked above ground, is granites; the ſecond ſort accumulated or incumbent on the granites is clay-ſlate, gneiſs or ſome other argillaceous rock; the third is limeſtone. Theſe general

neral and more ancient ſtrata of our part of the world are covered with ſeveral beds, which are of a more modern date, and conſiſt of clay, calcareous earth, marle, ſand, or that ſlate which lies in flats over the coal-beds, and is never to be confounded with the ſlate of primitive and older mountains, in whatſoever degree they may reſemble each other in their compoſition and ſubſtantial earth. The phyſical obſervation of the mountains, of their ſituation and beds, of the different time of their origin, of their connexion and their various accumulation is carefully to be diſtinguiſhed from the chemical and mineralogical examination of their conſtituent parts. A new ſtratum may very often conſiſt of the ſame earth or rock as the lower, more general, and more ancient ones; and notwithſtanding the ſimilarity of their ſubſtance, they may have been produced in very different times. On the contrary, it ſeems to be conſiſtent with the nature of things, that the ſame ſtratum, whatſoever extenſive it be, conſiſt of the ſame rock, if produced at the ſame time, or if this rock be found changing in a certain diſtance, that then it conſiſts of ſuch rocks that are ſimilar in their conſtituent parts, as gneiſs and ſlate. For this reaſon I have endeavoured to ſhew their ſimilarity; and notwithſtanding granites conſiſts of the

the ſame conſtituent argillaceous parts, it does not belong to the ſame ſtratum but to a lower and more ancient one. Many remarkable facts in the following deſcription of the *Bohemian* mountains will demonſtrate it; but it would be matter of an extenſive work if I ſhould attempt particular accounts of all the facts, which evince in *Bohemia*, that granites, clay ſlate, and limeſtone are conſtantly in that ſituation which I have indicated before. It would engage me to give a general view of the *Saxonian* and *Bohemian* metallic mountains, and of their run in the plains on both ſides. That would require a particular phyſical geography of all the mines at *Johan Georgenſtadt*, *Joachimſthal* and *Platte*, and of all the vaſt mountains between *Prague* and *Dreſden*. I have hinted here only a fact, which I could not paſs over ſilent. The evidences will appear in the ſequel, and may perhaps be given ſome day by me, if abler men ſhould not prevent me from doing ſo. But being again aſtray I beg leave, before I return to *Catharinaberg*, to obviate ſome objections, which might be perhaps oppoſed to this theory.

Though it is an undoubted fact that ſlate is accumulated on granites, and limeſtone on ſlate; though it is likewiſe fact that theſe three ſorts

of rocks are the moſt ancient, moſt extenſive, and moſt conſiderable ſtrata of the world, as far as we have explored its depth: there are however many other more modern, thinner and accidental beds, which either cover ſingle parts of the above primitive mountains, or are accumulated in the valleys and gutters, or on the ſlope of the higher mountains. We need not believe nor pretend that granite ſhould be every where covered with ſlate or limeſtone. No; there are in the contrary many places, in which it appears bare above ground, and in which it riſes to the ſide of the adjacent accumulated and ſuperincumbent ſlate or limeſtone-mountains. In the ſame manner ſlate appears often naked above the limeſtone. It is indifferent whether this have been ſo from the beginning or whether this may have been produced by inundations, earthquakes and other accidents, which have taken away their incumbent roof; nor does it alter at all the above rule of the three ſorts of incumbent ancient rocks.

Let us ſuppoſe that a granite-mountain, within the verge of the greater mountain-chains of *Europe*, be covered by limeſtone, this calcareous ſtratum ought to be conſidered as produced either in later times by a particular and partial inundation, or if really it ſhould belong to the third general and old limeſtone rock, the granites is to be ſuppoſed having appeared naked above the

ſlate

ſlate before this general limeſtone bed was accumulated; which very well accounts for the imaginary difficulty of the limeſtones being found now and then immediately incumbent on granites. The pre-exiſtence of the granites before the ſlate, and that of ſlate before the limeſtone, cannot be controverted, ſince they are incumbent on each other. No architect can lay the roof before having laid the foundation.

Before I can go on I have ſtill a previous remark to recommend. The examination of the phyſical origin, and of the common ſubſtantial parts of ſeveral rocks, ſhews their great ſimilarity and their inſenſible degeneration, as I have evidenced above by the example of clay-ſlate, gneiſs, horn ſlate, granite, quartz, mica and feldſpath. Hence in mineralogy, and the deſcription of mines, ariſes an indiſpenſable neceſſity to diſtinguiſh by conſtant names, the different degrees and varieties of the rocks. The name of *gneiſs* ſhould never be given but to the rock, which viſibly contains the three above ſubſtantial parts of its mixture; and that variety, which contains only mica in grey petrified clay, and which is deſtitute of quartz, ſhould conſtantly go under the name of *grey micaceous ſlate*. I allow this to be a violent diſtinc-

tion forced upon nature, ſince the three ſubſtantial parts of gneiſs are not conſtantly viſible, (which is the caſe at *Freiberg*) and grey micaceous ſlate is very often found with gneiſs in the ſame mountain; for being nearly related to each other, I cannot help wiſhing that the utmoſt care be taken in their denomination. Mineral bodies, I know very well, are not differenced by nature into different claſſes and families, as plants and animals; they are but different varieties and different mixtures. Nevertheleſs it is better to diſtinguiſh by words and intellectual diſtinctions things, which can be diſtinguiſhed, than to confound them and to be in want of proper expreſſions.

The mines at *Catharinaberg* are in the *Stadtberg*, which in its length runs between hour nine and ten of the compaſs, has a valley on both ſides, and is of about 340 fathoms diameter. Commonly the veins run in a direction which is parallel with that of the valleys and the mountains; but in this place three noble veins, and ſeveral inſignificant fiſſures, run a-croſs the mountain in hour two of the compaſs. Theſe are the *Nicolai*, the *Calves-head*, and the *Elizabeth* vein.

The *Nicolai* vein dips ſomewhat ſliding or ſlipping, *(tonnlegig)* § has no diſtinct ſide-ſkirts *(ſaalbænder)*

§ The dipping of veins and fiſſures is determined by their angles and inclination to the horizon, and accordingly meaſured

bænder) and is almoſt inſenſibly blended with and caſt in the mountain ſides. The vein-rock is commonly gneiſs as the mountain; but now and then it conſiſts of a ſpecies of granite. The gneiſſy-mountain-rock breaks and ſplits parallel to the dipping of the vein; but if veins between hour ſix and nine unite or croſs the main vein, the gneiſs next to the vein gets or affects a ſituation, which is parallel to the dipping of the croſs-vein. Wherever the mountain-rock turns harder and ſounder, the vein turns ſmaller and thinner. It is commonly not above one foot wide. A reddiſh irony clay ſoaks through the vein and incruſtates it. This commonly appears in the neighbourhood of richer ores. Fiſſures from the hanging

ſured by a quadrant. The *German* miners give them different names, which are expreſſive of their different inclination to the horizon.

A vertical or ſtanding vein dips or falls from ninety to ſeventy-five degrees.

A *tonnlegig* vein dips or falls from ſeventy-five to forty-five degrees; and has this denomination from *tonn* or *tun* and *legen* or *lay*, implying, that *tuns* or *caſks* or *barrels* laid on the hading of ſuch veins, ſink by their own weight to the bottom, and that accordingly ſhafts might ſtill be ſunk in them, which is a great advantage to the works. For this reaſon I ſhould not ſcruple to call theſe veins *ſliding or ſlipping* veins; as that denomination anſwers the idea of the *German* miners.

Flach-fallend veins dip from forty-five to fifteen degrees; and might very well be engliſhed by *flat veins*.

Schwebende Gaenge dip under fifteen degrees, and I do not ſcruple to call them *ſoaring veins*, as this denomination exactly anſwers the *German* name.. (Tranſl.

or from the hading, uniting with the vein, improve it. White fine clay with quartz is a forerunner of rich ore; coarſe white clay deſtitute of quartz forbodes no good, fills at laſt the whole vein and ſtrikes it deaf. Croſſing veins between hour ſix and nine are pretty common; alterate the direction of the vein; contain ſome quartz; are deaf in themſelves, nay ſtrike deaf the vein unleſs it be ſtrengthened by fiſſures from the eaſt. In this caſe the croſs-veins bring rich ores, which in the hading are commonly richer than in the hanging; but theſe richer ores are only to be found within the croſs.

Theſe obſervations of the *Nicolai* vein ſtand in general for all the veins at *Catharinaberg*.

The ore conſiſts of rich ſilver and copper-pyrites with blue fluor, blende, copper-glaſs, copper-green and ſometimes with ſome native ſilver and copper.

Commotau *in the Circle of* Saaz.

THE mountains from *Catharinaberg* to *Rothenhahn*, *Commotau* and *Sonnenberg* conſiſt of gneiſs, which in many places is fine micaceous and greatly quartzous. Some granite rocks appear in theſe parts above ground. Near the

the alum work at *Commotau* the gneiſs changes into that argillaceous ſlate, which is commonly found with coals. It is much impregnated with vitriolic acid, and properly roaſted produces alum. Impreſſions of vegetables are not uncommon in it, and it is to be queſtioned whether it might not be conſidered as a variety of gneiſs, or whether it be owing to a later origin, and to an accumulation in ſome valley or ſloping ground of the more ancient gneiſs, which is more probable. However, the aluminous ſlate at *Tolfa* in the *Roman* ſtate belong to the ſimpler or pretended primogenial mountains.

This ſlate is in the open fields put in ſquare pyramidal piles, fired and roaſted. Once fired it continues burning by itſelf; and is left ſo for ſome weeks till it is quenched by water. Its black colour is then found changed into red. During a year it is left expoſed to the air, and then three times ſucceſſively elixiviated; each elixiviation laſting about twelve hours. The elixiviated ſlate is during ſix months left in the air, till it be brought to the ſecond, and after a ſimilar diſſolution in the air to the third elixiviation. At the firſt boiling of the brine it is mixed with urine, and in the lead pans evaporated to a farinaceous powder; which afterwards is diſſolved in freſh water and by two ſucceſſive boilings brought to cryſtalliſation.

In former times they boiled likewiſe vitriol; but it was found unprofitable. The annual produce of alum is about 200,000 pounds, which, on account of the great number of alum-works in *Germany*, ſells at a lowered price of twelve florins per hundred weight. The other *Bohemian* alum-works at *Eger* and *Tans* are of no importance.

Theſe alum-works induce me to mention the *Bohemian* ſulphur and vitriol-works. Thoſe at *Alſattel* in the circle of *Saaz*, at *Naſſaberg* and *Groſslackowiz* are the moſt remarkable. The pyrites, after its ſulphur is extracted by firing, is dixiviated for vitriol. At *Kupferberg*, in the circle of *Saaz*, there might be produced towards 100,000 pounds of blue or cyprian vitriol; but there is no opportunity for ſale, tho' the price be lowered to fourteen florins per hundred weight.

Preſniz *in the Circle of* Saaz.

THE mountains conſiſt of gneiſs, which is white ſilver-coloured, blueiſh or dark-coloured. Detached baſalt-priſms ſhew that baſaltes is not wanting. They work here for ſilver and iron. 1. The ſilver-mine *Maria Kirchbaw*, is in a vein running to the ſouth, betwixt the hours twelve and one, and containing reddiſh ponderous gyps-

gyps-ſpar. In the deeper drifts native ſilver, and in the uppermoſt ones, nay to the very turf, other rich ſilver ores are ſaid to have been found of old. Even this gypſeous ſpar is ſuppoſed to contain ſome ſilver. It ſerves as a fluor in the copper furnaces at *Catharinaberg*. To the ſouth the vein is ſound; but to the north, in the ſloping of the mountain, it is ſhattered and deaf. A vein in which the gallery or drain was driven has united with the chief vein under the ſhaft, but without improving it.

The works are carrying on rather for the fluor, and for hopes, than for any preſent remarkable produce of ore.

2. *Orpes iron-mine.* It is a common obſervation, that flats commonly begin on the foot of ſimple, more ancient or pretended primogenial-mountains, where they ſink under the adjacent plains. However, the exiſtence of flats in the midſt of ancient mountains, and in their valleys, appears among ſeveral other evidences by the nature of this iron-work at *Orpes*, and ſundry others more to the north, which produce the ſame ore and are under ſimilar circumſtances. Partial and accidental inundations, as well as the ſucceſſive waſhing down of the decays of the neighbouring more ancient and higher mountains, will pretty well

well account for this phænomenon. ‖ At *Orpes* the undermoſt or loweſt ground is gneiſs, on which a large bed of ſcaly limeſtone is accumulated and incumbent. This is covered by a ſoaring vein or a bed of iron-ſtone thirty fathoms thick. The whole is buried under a white argillaceous ſtone ſtriped

‖ One of the moſt remarkable flats of this kind, which is undoubtedly a marine bed, has been more than once examined by the tranſlator. It is in the *Harz* foreſt between *Zellerfeldt*, *Altenaw*, and the *Calenberg*, in the midſt of ancient mountains, and appears there in ſeveral places near the *Feſtenburg*, the *Schulenberg*, and the *Calenberg*, not only in deep valleys as Mr. *Ferber* ſuppoſes, but even on and near the top of the higher ancient ſlate-mountains. Such is its ſituation on the ſides of the *Calenberg* and the *Schwarzeberg* towards *Altenaw*, and remarkably ſo near an inn, which is called the *Auerhahn* in a quarry known there by the name of *Shalke*. The tranſlator therefore is of opinion, that this flat or marine bed, as many others of that kind, is rather owing to more general revolutions and cauſes than Mr. *Ferber* ſeems to admit; though the partial cauſes, alledged by him, may be without diſpute admitted for thoſe ſecundary beds, which are deſtitute of marine bodies. The ſecundary marine bed on the higher *Harz* mountains is a very inſtructive phænomenon. It conſiſts of fine ſandſtone, commonly white, compact, fine grained and pure; and ſo it is found in the *Shalke*, and is cut into the form of grinding and ſcythe-ſtones. But in ſeveral places it is of a greyiſh or browniſh colour and mixed with ſome fine mica flakes. Such it is commonly near the *Feſtenburg*. It contains a great variety of fine impreſſions of ſcarce and moſt part unknown

ſtriped with mica, to the thickneſs of ſeven fathoms.

The above large ſoaring iron vein, if not rather iron ſtratum, contains the fineſt iron-coloured ores, which reſemble the *Swediſh*; ſuch as *ferrum refractorium mineraliſatum*, *tritura atra*, *textura chalybea*. LYTHOPHYL BORNIAN, p 124.

Ferrum refractorium, *textura granulata*, *granis minimis*. *Ibid.*

known marine ſea-bodies, as of *Aſteriæ columnares rotundæ perforatæ*.

Aſteriæ ſolutæ ſolares,

Oſtreo pectinites anomius veſpertilio alatus, whoſe impreſſion produces a ſpecies of hyſterolithus.

Oſtreopectinites anomius planus latior, whoſe impreſſion produces a ſpecies of hyſterolythus, peculiar to this place.

Entomolithus paradoxus, *trilobus tranſverſim rugoſus*; or a new and undeſcribed ſpecies of Cacadu or *Dodſley*-foſſil, peculiar to this place.

Conchæ minores læves; and *Cochleæ* and *Buccinitæ læves minores*.

The decays of this remakable ſandſtone bed appear many miles on the other ſide of *Goſlar*, in the plain country near *Kloſter Grachof*, and towards the *Steinfield*, in detached dragged and blunted ſandſtone pieces, filled with the ſame petrifactions which are ſcarce in themſelves, but the more ſo as included and moulded in ſandſtone, which is commonly deſtitute of petrifactions. I forbear in this place to draw conſequences from this ſingular fact; which, obvious in themſelves, prove to conviction that very violent cauſes have co-operated to raiſe and to deſtroy our higheſt mountains. (Tranſl.)

which

which are found with ſherl, garnets, wolfram, mica, hornblende, grey amianth, green ſudſlag, (*Cronſtedt Mineral.* §. 106. *Wallerii. Mineral.* Edit. 2. p. 398. 5 & 6.) and a deaf irony green clay, in which all theſe minerals are commonly ſticking.

The ſcaly limeſtone, which is the hading or the floor of this iron-vein or bed, is grey towards the ſouth. In both places it baſſets out.

The white argillaceous ſtone, ſtriped with mica, which is the hanging or the roof of this vein or bed, ſeems to be produced by the decays of the adjacent mouldering higher gneiſs-mountains. This ſucceſſive accumulation is ſupported by ſeveral argillaceous beds in the neighbourhood, ¶ and by many pieces of foſſil wood, which are penetrated with iron, and are ſo frequent in the upper flats of the argillaceous ground near *Orpes* that even ſome good iron is extracted from them.

¶ Near *Preſnitz* they dig in a gallery a green painters clay *Cronſtedt*, §. 79, and near *Kaaden* white *China*-clay, with a white grey, milky, opaque, argillaceous ſtone, which is ſmooth and gloſſy in its fractures and a production of the *China*-clay, as appears by the looſe clay contained in its middle. Mr. *Peithner* has deſcribed it in his *Mineralogical Tables* under the name of *Porcellanites*- *China*-clay is found in ſeveral other places in *Bohemia*, for example, at *Lumpe*, near *Bochmiſh Gieſshubel*, at *Zitolib*, on *Sonnenwirbel* near *Weyperth* at *Laun*, *Marklin*, *Hlubloſs*, &c,

Weiperth

Weiperth *in the Circle of* Saaz.

THE following mines are working here for ſilver and cobolt. 1. *Clementis-Stolle.* The mountain rock is gneiſs; the vein not opened yet. Where it baſſets out they have found under the turf a ſpecies of very rich brown ſilver-ore. It ſeems to have been horn-ore; but want of knowledge and curioſity has deſtroyed it by unconcerned ſmelting. The ſituation of the ground did not permit to drive the gallery in the vein; they have therefore driven it in the gneiſs, but ſo unwiſely, that they have not thought neither of a place where to put up the rubbiſh, nor of the neceſſity to include the brook which runs before the entrance, and of courſe overflows it as often as it ſwells by ſudden ſpring-or autumn-waters.

2. *S. Anthony Stolle* is driving in the vein, in a gneiſs-mountain. On the ſole of the gallery the hanging is ſlate, and the hading gneiſs. This ſlate is a branch of the neighbouring metallic mountains in *Saxony*, and a variety or degeneration of the gneiſs, which appears clearly in this place, where they border together. They have found in this gallery ſome ſilver and cobolt.

3. *S. John*

3. *S. John in the Desart.* The vein runs in gneiss.

Joachimsthal *in the Circle of* Saaz.

ALL the *Bohemian* metallic mountains, from *Catharinaberg* hither, consist generally of gneiss, which is a mixture of visible quartz, mica and a whitish clay. Near *Joachimsthal* this visible difference of the constituent parts disappears, and they are so closely mixed together, that the rock thence produced is to be called grey micaceous and quartzous clay-slate. It is the common rock of all the mines at *Joachimsthal*, and turns less micaceous in the depth, where it is more argillaceous, soft, lamellous and black, and the more resembling to the argillaceous slate of other metallic mountains, especially those at *Clausthal* in the *Harz forest*. However, the grey micaceous clay-slate continues in some mines to a great depth before it changes its nature.

The metallic mountains at *Joachimstahl* are towards the south of a gentle ascent, run in different ridges to the east, to the north, and to the west (the highest being that which runs to the north) and to the frontiers of *Saxony* sink down again in the plains. The valleys between these ridges are extremely deep; accordingly the hills are remarkably

ably high, which has afforded to the miners a good opportunity to work many galleries, which from every ſide converge to the ſouth, and to the valley in which the city of *Joachimſthal* is ſituated.

Theſe ridges are to the ſouth; the *Adelſgreen*, and the *Little Mittelſberg*; to the north-eaſt riſes the *Turkner*, and in the weſt the *Pfaffenberg*; to the eaſt is the *Hoheberg*; to the weſt the *Upper-Turkner*, the *Shottenberg*, the *Kohlberg*, the *Keilberg*, and the *Under*-and *Upper Niclaſberg*. All theſe hills are very ſteep, and naked. Their exterior mould is ſandy and barren. The facility of working by galleries has induced the miners of old to ſearch the numerous veins from every part. Hence that aſtoniſhing number of old galleries. Above forty of them are ſtill working, and many of them, for example the *George* and the *Thereſia* ſtolln are driven a length of 450 fathoms.

All theſe galleries and works of *Joachimſthal* are divided into ſix different fields, and belong to the following companies their tenants.

1. *Unity*, belongs to the community of the citizens at *Joachimſthal*.

2. *Hohe Tanne* is belonging to the imperial court.

3. *Hubert* or *Helena-Hubert*.

4, *Friedenfield*.

5. *Schweitzer Gewæltigung*, divided between the court and private companies.

6. *Sæchſiſh*,

6. *Sæchſiſh Edelleuth-Stolln*, and *Apple-tree-Stolln* at *Abertham*, belongs to private aſſociations.

All of them are drained by two deep canals or levels, *Barbara* and *Daniel*. The former has its door in the city, and including its ſeveral wings is driven 4,500 fathoms. In a direct line it is 1600 fathoms, and its ſole is 170 fathoms perpendicular under the higheſt top of the mountain. It was the deepeſt gallery of the ancients. *Daniel* is, including its wings, driven 5600 fathoms, and in a direct line 1500 fathoms. It runs twenty fathoms underneath the ſole of *Barbara*, empties under the town more to the ſouth. Theſe draining-levels are kept in repair by the court, for an allowance of a ninth part of the profits.

There are but three drawing ſhafts for all theſe mines. *Hohe-Tann* dips ſomewhat ſliding nearly in 73 degrees. Its whole depth is 60 $\frac{1}{2}$ fathoms. *Unity-ſhaft* is 154 fathoms perpendicular. *Hubert-ſhaft* is 70 fathoms perpendicular. Hence ariſes the neceſſity that theſe ſhafts ſerve by alternate turns to different mines and aſſociations.

The works are every where ſunk much underneath the ſole of theſe ſhafts and galleries, ſo that theſe mines, after thoſe in *Tyrol*, are the deepeſt in the world. They have from 200 to 350 fathoms perpendicular depth under the turf.

Conſidering

Conſidering the ſituation of the high and ſteep hills, which go under the collective name of the *metallic-mountains* of *Joachimſthal*, and which are ſeparated by deep valleys, one would be inclined to think that the aſcent, fall, and direction of their rocks and veins muſt be correſponding with their exterior form. That is commonly the caſe in other metallic mountains. But here, contrary to ſuch obſervations, the rock generally aſcends from the ſouth, and ſinks either to the weſt or to the north, as in ſome reſpect will appear by the run of the veins, which is abſolutely unaffected and undiſturbed by the direction of the valleys, except that it ſeems to influence their quickneſs.

Theſe veins are very numerous; they fall into an indefinite depth, and continue quick and metallic 350 fathoms. In reſpect of their general run and direction, they are by the *Bohemian* ſurveyors and engineers divided into *midnight and morning veins*.

The *midnight* or *northern-veins* run from ſouth to north, between the ninth hour and three, dipping from eaſt to weſt from 54 to 78 degrees, being in general *ſliding veins*.

1. Gold-roſe hading fiſſure runs in hour — — — 1 : 6 $\frac{1}{4}$ line.
2. Gold-roſe hanging fiſſure runs in — — — — 12 : 5 $\frac{1}{2}$

3. Franciſca — — 9: line.
4. Anna — — — 8:7
5. Fundgrube — — — 12:6½
6. Backer-vein — — 1:7½
7. Hilbrandt — — 12:6½
8. Geſhieber — — 10:4
9. Roſe, from Jericho, in hour 2:3
10. — — hading fiſſure 1:3
11. Joſeph — — — 12:1½
12. Bergkitler-vein — — 1:2½
13. Schweitzer — — 1:2¼
14. Ioung Schweitzer — 2:4¼
15. Jerome — — 1:7½
16. Geiſter-vein — — 12:4
17. Flat-vein — — 12:7
18. Matheſi-vein — — 2:2

The *Morning* or *Eaſtern*-veins run from eaſt to weſt between hour 3 and 9, dipping from ſouth to north from 60 to 73 degrees, being all of them *ſliding veins*.

1. Lawrence runs in hour — 5:1½ line.
2. Francis de Paula — 5:5
3. Joachim — — — 6:0¾
4. Suſann — — — 6:3
5. Kayſerthum — — 6:3¼
6. Corona — — — 5:2
7. John in the Deſart — 6:0½
8. Urſula — — — 6:6¼

9. Three

9. Three Kings — — 6 : 5 $\frac{1}{4}$ line.
10. Hutten plan — — 6 : 4 $\frac{1}{2}$
11. Morice — — — 6 : 2 $\frac{1}{2}$
12. Seegen-Gottes — — 5 : 7 $\frac{1}{4}$
13. Geyer — — — 5 : 7 $\frac{1}{2}$
14. Andreas — — — 7 : 2 $\frac{1}{4}$
15. Trinity — — — 5 : 7 $\frac{1}{4}$
16. Heer-Paukner — — 7 : 0 $\frac{1}{2}$
17 Fundgrubner — — 7 : 0 $\frac{3}{4}$
18. Spathgang — — 7 : 2 $\frac{1}{2}$
19. Cow-vein — — — 7 : 0
20. Waſſerſtolln — — 6 : 6
21. Michael — — — 6 : 4 $\frac{3}{4}$
22. James Major — — 6 : 6 $\frac{1}{4}$
23. Roſner — — — 6 : 0 $\frac{3}{4}$
24. Elias — — — 7 : 0 $\frac{1}{2}$
25. Saxen-Kerl — — 6 : 3 $\frac{1}{4}$
26. George Stoln — — 6 : 3 $\frac{3}{4}$
27. Old Saxen-Kerl — — 7 : 3 $\frac{1}{2}$
28. Tirre Schonberg — 6 : 1 $\frac{1}{2}$
29. Himmels-Krohn — — 7 : 0

There are beſides them many other midnight and morning-veins, either uniting with the former, or running by themſelxes; but not having been yet examined they are ſtill deſtitute of proper names.

In order to give a general idea of the mines at *Joachimſthal* I have annexed a general map in plate, I. The richeſt veins are among the nor-

thern ones: *Geſhieber*, *Fundgrube*, *Roſe from Jericho*, *Berg-Kittel* and *Jerome*; among the morning ones, *Morice*, *Geyer*, *Andreas*, *Cow-vein*, *Elias*, *Old-Saxon-Kerl*, *and George Stolln*.

The vein rock in the northern as well as the eaſtern veins is aſhgrey, yellow, white or blueiſh clay, argillaceous ſlate, and various coloured but commonly red hornſtone *(petroſilex)* which is the matrix of the richeſt ores. The *Roſe-ſpar* is a calcareous ſpar, conſiſting of accumulated roundiſh and twiſted lamellæ, found in the vein called *Roſe from Jericho*. The midnight or northern veins contain for the greater part a very fine red hornſtone, ſemi-pellucid and of a pleaſant colour. It has not yet been found in any morning vein. As ſoon as this red hornſtone appears the clay breaks off, but preſently returns at the end of the hornſtone. They are conſtantly alternating, but ſeem to be of the ſame ſubſtantial mixture.

The *Paukner-vein* has not ſhewn any thing yet but ſlate intermixed with arſenical pyrites.

The *Fundgrube* is either entirely filled up with flintlike grey hornſtone, or holds it in neſts and nodules.

The width and thickneſs of theſe veins are various, from one inch to two feet. The ſame vein appears very different in its thickneſs; they

are

are often ſo much compreſſed that no vein but a ſimple joint only is to be diſtinguiſhed. The hardneſs or ſoftneſs of the mountain-rocks have a ſhare in it; nay, the mountain and vein rocks turn ſofter as ſoon as the vein itſelf turns quicker and nobler.

The veins do well in general in the aſcent of the mountains; and richer ores are ever to be expected in the croſſings of the northern and eaſtern veins. If both veins be filled with clay there is no chance of ore.

If one be filled with quartz or calcareous ſpar, and the other with hornſtone, the ores turn rich in the croſſing; infallibly if two veins, one argillaceous and the other hornſtone, by dipping croſs one another, rich ores are produced.

In theſe croſſings the veins are now and then diſturbed in their run and dipping, and if they do not improve they are ſhattered.

Ramifications or fiſſures ſeparating from a vein, and uniting afterwards to another, raiſe its value and thickneſs, eſpecially if they ſhould happen to unite with it in an acute angle, and continue to run with it for a conſiderable length. This happened in the *Geyer*, where they

have at preſent a proſpect of the richeſt ores. However, the contrary happens likewiſe, and veins have been by the uniting fiſſures ſo much compreſſed and ſhattered, that ſcarce any track has been left remaining; then experience has taught, to trace the run of the deſtroyed vein by that fiſſure, which contains a thin covering of clay one ſingle line thickneſs.

The fiſſures of the *Roſe from Jericho* in the hading are ſcarce ever worth working, though commonly larger than the vein itſelf.

Beſides theſe metallic veins ſome deaf ones, of a conſiderable thickneſs, go a-croſs theſe argillaceous and metallic-mountains. They are called here *combs (kæmme)* and deſerve particular notice. Some of them conſiſt of red *porphyry*, which is called here ſandſtone, and ſome of a ſpecies of trapp, which is called here wacke.

The *porphyry* conſiſts of a red fleſh-coloured hornſtone *(petroſilex)* and milky feldſpath grains, in which ſometimes vitreous quartz-grains may be diſtinguiſhed. In ſome places this *porphyry* is ſoft and unpetrified. Then the feldſpath grains are caſt in a reddiſh loam. So I found it in the *Kuhgang*. Some large veins or combs of this porphyry croſs the metallic mountains at *Joachimſthal*, commonly from ſouth

to

to north. They unite with the veins, run parallel with them and croſs them, now and then improving their metallic value. Such a porphyry vein is next to the *Cow-vein*; two of them are cloſe to the *Schweitzer*, one near *Elias* on *George-Stolln*, but the largeſt, and till yet the only improving one, has been found on the *Roſe from Jericho*. Here it has in the hading united with the vein, and has produced the richeſt glaſs-ores which ever have been dug in this mine, but broke it off with the porphyry. The whole width of this porphyry-comb has not been exploit *broke* it is ſuppoſed to be at leaſt eight or ten fathoms. In its cracks and fiſſures this improving porphyry-comb contained a remarkably fat clay; nay the porphyry ſoftened by it as other vein-rocks turned rich.

The *Combs*, conſiſting of a ſpecies of *Trapp* or hardened irony clay, are commonly of a grey and greeniſh colour. Some are black, and in this ſpecies white calcareous ſpar-grains and greeniſh ſherl are found in the *Cow-vein in the Unity*. Their run is very regular. Their width and thickneſs from ſome inches upwards to forty fathoms, remakably large where they baſſet out. They unite, run parallel with the metallic veins, and croſs them either to their improvement or to

their various diſadvantage, ſtriking them deaf, altering their run, or compreſſing them ſo as to be with great pains to be found again. Under ground theſe combs are often ſo hard that they cannot be worked but by blaſting; but croſſed by galleries, or by other accidents expoſed to the air, they wither and moulder into that argillaceous earth which formed them, change their colour to yellow and ochraceous, and turn very ſaponaceous. This clay for the greater part diſſolves in water. In reſpect to their run and direction they are hereabout as other veins called *Morning* or *Midnight-Combs*. The former croſs the metallic midnight-veins and dip from north to ſouth. The latter croſs the metallic morning-veins and dip from eaſt to weſt. Some of them are entirely perpendicular.

There have been found above thirty *Morning-Combs* which baſſet out. One of them *Schon Erz* is thirty fathoms where it baſſets out. Five ſuch *Wacken*-veins have been croſſed by the works between the *Cow-vein* and *Elias*. The *Roſe from Jericho-vein* is croſſed on the level of the *Daniel-Gallery* by three ſuch combs, fourteen, nine and eight inches, two of them twenty fathoms deeper have united together, and with the vein, which has

has been ſo much improved by this accident, that *Wiſmuth* has begun to break in the hading.

The *Midnight-combs* or *Wacken* commonly diſturb the run of the metallic morning-veins. The *Cow-vein* is croſſed by three large combs; two of them are on the *Thereſia-drain* near the *Geyer*, under ground from ſome inches to ſix feet; but where they baſſet out they have a thickneſs from thirty to forty fathoms. The third comb is grey, and on the *Barbara-Sole*, between thirty and forty fathoms. In this place, which is 150 fathoms perpendicular depth, and about 3000 fathoms diſtant from the door of the gallery, they found of old, that famous antidiluvian tree, which is the more remarkable as it lay in the midſt of theſe ſlate rocks and the comb I am ſpeaking of. The exterior appearance; the inner ſtripes or fibres; the concentric circles; the ramification of this ſubſtance into round branches; the ſoft bark which ſtuck to them; and ſomething like leaves found in ſeveral parts of this grey ſtone, or even on this ſubſtance itſelf; in ſhort, every viſible circumſtance convinced the firſt diſcoverers of their having found one or more petrified trees in the midſt of the mountain; and the pious ſimplicity of theſe former times, which conſidered the moſt natural phænomena as prodigies or ſigns of divine warnings, dared not conſider theſe trees

trees but as having been buried here by the deluge, as appears by the name of this petrified wood, and by the different accounts of *Mattheſius* in his *Sarepta*, and in his *Chronicle of Joachimſthal*. Soon after this diſcovery the water prevailing, and this whole drift of the cow-vein giving way, it has been ever ſince either impoſſible or extremely dangerous to examine this place, which is ſo curious for Naturaliſts. Many mining officers at *Joachimſthal* have ſince attempted to doubt whether theſe pretended antidiluvian wood-like blocks ever have been real wood. They have conſidered them as a fibrous and black variety of the grey comb-rock, which they ſuppoſed generally toriſe from this place, and thence to diverge in the ſeveral ramifications, which croſs the mountains at *Joachimſthal*. This laſt ſuppoſition cannot be admitted, as theſe combs are ſo very different in their direction and dipping. But even the firſt ſuppoſition is deſtitute of foundation, unleſs a man ſhould allow to himſelf to conclude from the remarkable ſcarcity of petrifactions, in the ſimpler or pretended primogenial mountains, that no ſuch petrifactions are to be found or to be admitted at all. A Naturaliſt cannot help wiſhing to ſee theſe old drifts and caverns cleared again, in order to take fuller information of this ſingular phænomenon; but hitherto no information is to be had except what

may

may be gathered from the accounts of *Mattheſius* and thoſe fragments which are kept in ſeveral cabinets. Their ſimilarity with other petrified wood, eſpecially with beech-wood, is ſo ſtriking, that even the very firſt ſight of it keeps down any doubt which you might have entertained againſt it, except you ſhould be inclined to look upon the petrified wood in general as *luſus naturæ*. I remember to have ſeen in Baron *Pabſt von Ohayn's* collection at *Freyberg* ſome very unequivocal ſamples. It was impoſſible to miſtake the wood fibres, the yearly annular circles, the ramification of the branches, their roundiſh form and the ſoft unpetrified bark, which ſome people have falſely ſuppoſed to be amianthine foſſil cork *(ſuber montanum.)* I cannot ſay any thing of the leaves, ſince I never did ſee them; but for my part, I am perfectly convinced that it is really petrified wood, and that I may rather depend upon the evidence of my eyes than upon the objections of ſome wiſe pyrrhoniſts, who might conſider even the petrified ſhells of calcareous ſtrata as ſports of nature.

Subterraneous caverns have not been found generally but in calcareous hills. However, I know by very good authority, that a cavern of a remarkable width has been diſcovered in theſe argillaceous metallic ſlate mountains at *Joachimſthal*, in the midſt of ſolid rocks, and in a depth of

250 fathoms. It was hit in 1772 by the fifth drift, driven by the *Hoh-Tanner* company on the *Andreas Vein*. A ſhort time before they had fine ore in the vein from an half inch to three inches thick; but ſuddenly, when the miners worked a blaſting hole in the hading, a violent ſtroke from under ground forced the bore from their hands, and a flood of water, ſpouting not only from the hole, but breaking forth from every rock fiſſure, overflowed the whole drift, and obliged the miners to fly. Soon after the water ceaſed to break in from the roof a head, but it continued violently to ſpout from the bore hole to a diſtance of three fathoms. The engine could not overcome this ſubterraneous inundation till a ſecond wheel was ſet to work, and the drift was drained again, which facilitated the going on with the works, and the breaking into a cavern eleven fathoms length and nine fathoms wide. Its roof appeared foul and ſhattered; its floor was craggy by large rock maſſes tumbled from above; and it was ſtill filled with water, which made it impoſſible then to explore its depth. The ſixth drift or level of the works has ſince been extended and driven towards the ſame place; however, its depth or bottom is ſtill unexplored.

Having giving the names of the ſeveral patentee-companies, and of the ſeveral fields which they

are

are working, I ſhall here take notice of the veins, which fall within the extent of their works.

The field of *Hubert* is croſſed by *Geyers*, *Paukners*, *Trinity's*, *Fundgrube*, *Baker*, *Geſhieber*, and *Anna* veins.

Unity works on *Andreas*, *Geſhieber*, *Cow vein*, *Seegen Gottes*, *Fundgrube*, *Backer*, *Hillebrand* and *Roſe from Jericho.*

Hohe Tann works on *Geyer*, *Seegen Gottes*, *Andreas*, *Roſe from Jericho*, and *Elias.*

Fridenfeldt on *Cow vein*, *Roſe from Jericho*, *Schweitzer*, *Chriſtopher*, *Joſeph*, and ſeveral croſſing morning veins.

The field of *Sæchſiſh-Edelleuth-Stolln* (or the *Saxonian* gentlemens gallery) is ſeparated from the former fields, and ſituated in an argillaceous ſlate-hill, called the *Dirnberg*, which is independent of, and divided by a valley from the other metallic mountains. It is the higheſt top to the eaſt of *Joachimſthal*; has its own veins, which ſeem to have no connexion with thoſe in the metallic mountains. Being emptied towards the day, the works are driven already above 100 fathoms below the level of the valley. Its veins are likewiſe divided into eaſtern and northern veins.

The *Northern* or *Midnight Veins* are,

1. *S. Thomas*; runs in hour ten three lines, dips in fifty degrees to the eaſt. It has two ramifications, which

which turn deaf where they unite. The vein-rock is white calcareous ſpar, red hornſtone (*petroſilex*) and blende.

2. *Margaretha Vein* runs in hour eleven ſix lines; and ſpreads in two ramifications. They are metallic as far as they are yet purſued. The vein-rock is clay, and argillaceous ſlate ſprinkled with pyrites.

3. *Hulf-Gottes-Vein* runs in hour eleven five lines; dips in ſeventy-five degrees, and ſpreads its fiſſures and ramifications in the hading, which from twenty to twenty fathoms unite again with the main vein. The ramifications ſeparating from it make it deaf, carrying the ore along with them in the hading; but uniting again with it they make it quick and fair again. This ſeems rather to indicate two veins conſtantly and alternately ſeparating and uniting. The vein-rock is argillaceous ſlate, clay, pitch-blende or black jack.

4. *Wolfs-Vein* runs in hour nine and three lines; dips in ſeventy-five degrees; is never quick but in croſſes.

5. *Daniel* runs in hour nine and five lines. Is worked out.

6. *Newheuſler* runs in hour ten, is worked out likewiſe.

7. *Zeitler* runs in hour twelve, dips in eighty degrees.

The

The *Morning Veins* croſs the above northern ones, and are, 1. *Reichs Stollner Vein* running in hour five dipping in ſeventy-five degrees. 2. *King Saul* running in four and five, dipping in eighty-five degrees; both having in former times produced very rich ores, and are on that account worked out.

I ſhall only take notice here of the moſt remarkable ores found in theſe ſeveral veins at *Joachimſthal*, as Baron *Born*, in the printed account of his cabinet, has accurately deſcribed all their varieties, and the vein-rocks in which they are contained. But previouſly I am to obſerve, that all the ores of theſe veins are deſtitute of viſible coverings, nay that often they appear ſprinkled in the hading and hanging rocks, though the veins in themſelves be not immediately grown to the rocks, but rather ſeparated from them by thin argillaceous joints. To ſave the ore which is ſprinkled in the rock ſides of the vein, they are cut down on both ſides of the vein one foot thickneſs, and delivered to the waſh-works.

The moſt remarkable ores at *Joachimſthal* are as follows:

1. *Native ſilver* in different vein-rocks; in *Shard Cobolt (Scherben-Cobolt)* and on the black wacke it appears in capillary forms, and is called then *Bruſh-ore*. Native ſilver has been found in *Geſhuber*,

Geſhuber, *Schweitzer*, and *Cow-vein*; though more common on theſe veins it has never been plenty.

2. *Glaſs-ore* is the richeſt ore at *Joachimſthal*; one hundred weight is commonly valued at 180 marks of ſilver. They melt it in lead in order to part it. It is in undetermined, cryſtalline, and grape-like forms, and has been found in former times on *Cow-vein*, *Roſe from Jericho*, and *Schweitzer*, in ſo large lumps and maſſes, that ſmall pyramids, ſtatues, and many ornamental toys, have been carved of it, as appears from the accounts given by *Matheſius*, and from the many curioſities of that kind kept in the electoral cabinet at *Dreſden*. Large cryſtalline pieces of glaſs-ore, found in former times, are kept for ſale in the archives at *Joachimſthal*.

3. *Red ſilver-ore* found, in undetermined and in cryſtallized forms, is found on *Andreas*, *Geyer*, and *Backers-Veins*, in arſenical cobolt; in *Trinity* its matrix is arſenical pyrites; in *Geſhuber* it is red hornſtone *(petroſilex)* and on *Roſe from Jericho* it is roſe-formed lamellous calcareous ſpar. This laſt variety, which is at preſent very ſcarce, is in reſpect of its ſingular beauty preferable to any other. The cryſtalline, ruby coloured, and pellucid red ore ſticks on, and often in the midſt of the above lamellous roſy-ſpar, which on that accident reſembles now and then to a roſe or ranunculus, and has given the name of that flower

to

to the vein in which it is found. A connoiſſeur will, by the very colour of the red ore, gueſs the mines in which it is found. The *Bohemian* red ore is remarkably fine ruby coloured and pellucid; that from *Andreaſberg* in the *Harz-foreſt*, is ſomewhat darker, on account of its ſtronger mixture with ſulphur; and iron that from *Saxony* keeps the middle between theſe varieties. *Agricola*, in the tenth book *de Natura Foſſilium*, is of opinion, that the red ore from *Joachimſthal* on the *Barbara vein* is auriferous; which by the aſſayers is denied. I had no leiſure to try it myſelf.

4. *White ſilver-ore* is ſaid to have been found in former times on *Andreas* and *Roſe from Jericho* in pyrites.

5. *Lead-Glance*, containing ſome ſilver, found in former times on *Geyer*, and in 1730 on *Cow-vein*, in one foot thickneſs. Such poor ores are generally ſcarce in the veins of finer ones.

6. Yellow copper-ore and pyrites, ſaid to have been found in *Seegen Gottes*.

7. *Cobolt* in different argentiferous varieties occurs with ſeveral ſilver ores in the *Geſhuber*, *Hillebrandt*, *Roſe from Jericho*, *Schweitzer*, *S. Eſprit*, *Emperor Joſeph*, and other veins. The pure cobolt, deſtitute of ſilver, is ſtampt and ſold afterwards to ſeveral cobolt-manufactories in *Bohemia* and the *Empire*. A hundred weight ſells from

thirteen to forty-five florins. In former times, the demands of that commodity being then leſs, they produced in the whole Kingdom not above 200,000 pounds; at preſent they produce about 1,000000 of pounds. In the moſt ancient times cobolt-ores were by ignorance thrown amongſt the rubbiſh; for this reaſon the bing-places at *Joachimſthal* are ſearched over at preſent, and ſome waſh-works after the *Hungarian* principles are to be ſet up. The greater part of the *Bohemian* cobolt is exported to *Holland*. Though the *Bohemian* ores are as good as the *Saxonian* ones, the preparation of the ſmalte is not brought hitherto in *Bohemia* to the ſame mechanical perfection as in *Saxony*, where the manufacturers are never at a loſs to work exactly the ſamples demanded. This ſeems owing to an imperfect ſeparation of the ores, and to ſome ignorance of their nature and manipulation.

8. *Pitch Blende*, containing ſometimes three marks of ſilver, ſaid to have been found in 1772 on *Geyer's vein*, occurs in ſome other mines.

9. *Arſenical ore*, miſpickel, now and then with ſome orpiment found with the cobolt and ſilver ores. In the old works on the *Hubert-vein* a white arſenical calx drips and coagulates into ſtalactites.

10. *Cinnabar-ore*, according to *Matheſius* and *Albinus*, formerly found in *Dorothea-vein* in the *Shottenberg* at *Joachimſthal*.

The

The hardneſs and ſolidity of the argillaceous ſlate or of the mountain rock is a great advantage to the works, ſince in moſt places they want no timber.

The engines are built according to the principles of thoſe which are uſed at *Shemniz*, and which have been deſcribed by Mr. *Poda*. The ſame is to be ſaid of their waſhing and ſtamping mills.

The hiſtory and the former riches of the mines at *Joachimſthal* have been deſcribed by Mr. *Peithner*, in the ſecond volume of the *New Phyſical Amuſements*, publiſhed at *Prague* in 1771 in Octavo.

Aberdam *two hours way diſtant from* Joachimſthal.

THE mines lie on the limits of the deeper granite and the incumbent argillaceous ſlate, and afford an eaſy opportunity to be convinced of the granites being under the ſlate.

Some veins at this place run in grey micaceous ſlate, and contain ſilver and cobalt-ores; ſome in reddiſh or alternating grey granite, which here, as commonly in *Bohemia* and *Saxonia*, contains tin ore, though ſome tin-veins are obſerved likewiſe to be in argillaceous ſlate.

Eva's Apple-tree and *Jerome* are the chief ſilver-mines at *Aberdam*. Theſe veins are at a depth of ſixty fathoms, and by uniting with red porphyry veins become remarkably richer. I have ſeen native ſilver, in wires and in capillary forms, in yellow, brown and black horn-ſtone (*petroſilex*) with glaſs-ore; and hair ſilver in cobolt, both found in *Eva's Apple-tree*.

The *Morrice-mine* and ſome others are in granite, and are worked for tin.

Mattheſius and *Albinus* tell that a tranſparent cinnabar-ore has been found formerly in *S. Lorence* at *Aberdam*.

Platte *in the Circle of* Saaz.

HERE are three different ſorts of mines, ſilver, iron and tin-mines.

Zwittermill is a high mountain two hours diſtant from *Platte*.

Its eaſtern part conſiſts of aſh-grey micaceous ſlate or a ſpecies of gneiſs, in which *Trinity ſilver-mine* is working. Its weſtern part conſiſts of ſolid compact hornſlate or a mixture of quartz and mica, thoroughly mixed and penetrated with ſome iron. This hornſlate is extremely hard and ſonorous as metal. It belongs to the *Corneus Wallerii*. They dig it in a quarry, cut it into the form

form of peſtels, and uſe it hereabout, and as far as *Johan Georgenſtadt in Saxonia*, inſtead of iron ones, as being leſs expenſive and leſs obnoxious to the tin-ore. For this reaſon this hornſtate is called hereabout *poch wacke*. *S. John Baptiſt's* vein croſſes this rock, and conſiſting of blackiſh, more or leſs micaceous deaf clay ſlate, its working has been given up. The hornſtone in the hanging and hading of this vein is ſofter than the common *poch wacke*, grey coloured, mixed with mica, and ſimilar to the grey gneiſs on the eaſtern ſide of this mountain; whence it appears that this hornſtone is but a variety of the eaſtern and general rock of the *Zwitter-mill*.

In *Trinity* mine on the eaſtern part of this mountain two veins are working, called *Heavenly Bleſſing* and *Divine Providence*. To the weſt they are compreſſed by the hornſtone; but they may very likely in a greater depth unite and fall in together by their dipping, and then prove quick and metallic. It is obſerved in this mountain, that the ſilver morning-veins, running in hour 7 or $7\frac{1}{2}$ are quick and metallic if ſtanding or vertical; if they dip leſs than 45 degrees, that is flat or ſoaring, they are deaf.

2. *Irrgang* or *Labyrinth* is a large iron vein, which all along its run in hour nine, line four, for a ſpace of about three *German* miles, as far as *Annaberg* in *Saxonia*, is worked by ſeveral com-

panies. Each of these companies gives to its field and part of the vein a particular name. For example, *Maria Hulf mine* near *Platte* calls it *Hilf Gottes-vein*. Here the hading is granite, and the hanging slate; and it has been observed to be richest where running between these rocks. Commonly it runs in granite, which often contains sherl; and it gets a hanging of slate in those places where it runs into the incumbent slate. They told me, that this granite-rock contains some wedges of basaltes. Crossing foul and argillaceous veins force this iron vein into a different direction; but constantly it returns to its rule and main direction. It is about four fathoms wide, and yields the finest red button-ore and other argillaceous red iron-ore, which often appears in a thickness of one fathom. Now and then brownstone or manganese is found with the button-ore, and they use it as a flux.

The *Tin-mines* near *Platte* are all of them in granite.

S. Conrad is the chief of all, and works the following veins:

1. *S. Christopher's vein*, running in hour 11, points 6, dipping in 72 degrees.

2. *Fresh-fortune's vein*, running in hour 11 $\frac{1}{2}$, dipping in 82 degrees.

3. *Conrads-vein*, running between hour 8 and 9, and makes a cross with the two former. It dips in 82 degrees.

4. *Christ*

4. *Chriſt birth's vein* runs in hour 3.

5. *Matthiew'i vein.* They baſſet generally out with tin-ſtone, which formerly has been waſhed and thus furniſhed an opportunity for diſcovering the veins. The rock, in which they run, is reddiſh and grey granite, ſometimes greeniſh. Their vein rock is looſe granite with parallel layers or ſtripes of zwitter; which diverging from the vein make it extremely thin. Generally it is from one to four fathoms wide; and ſo it was about the middle of its depth. The deepeſt pit is eighty fathoms; the vein ſtill quick. White yellow clay or lithomarga, blackiſh mica, and fine pointed black wolfram or pyrites are found with the tin-zwitter. The wolfram is here in deaf veins, the conſtant fore runner of tin. The croſſings of the veins, and of the ſmaller vertical or flat fiſſures running in hour ſix improve theſe veins in general.

Gottes Gab *in the Circle of* Saaz.

IN this place there is at preſent no mine working except in the *Kaff*, a mountain conſiſting of micaceous and quartzous clay-ſlate. They dig here in ſeveral pits, ſuch as *John in the deſert*, *Tubal-Cain*, iron ore, good loadſtones, and rich but irony tin-zwitter. Accidentally they meet

likewiſe with copper and ſilver-ore; nay there have been found ſamples of ſilver, copper, iron and tin ſticking in the ſame matrix.

The miners ſuppoſe that an iron-flat or bed is incumbent here on a tin-flat or tin-ſtratum; but that is inconſiſtent with the height and nature of the mountain, which is a ſimple or true gang-or primitive mountain. Several veins, vertical as well as flat ones, croſs it. The latter carry iron and tin, and being flat and ſoaring have been by the miners miſtaken for flats. The vertical veins ſtrike them deaf; and they yield leſs tin as ſoon as they are united with ſilver fiſſures; this ſeems to be owing to the ſame cauſe, which in the *Saxonian* metallic mountains produced ſilver in arſenical veins (and ſuch are the tin-veins) wherever they are croſſed by irony fiſſures. Inſtead of cobolt, miſpikkel, tin and other arſenical ore, they yield then ſilver-ore. Though ſuch particular obſervations are far from eſtabliſhing general principles, and the alchymiſtical concluſion, that iron and arſenic produce ſilver, might prove too bold and too raſh perhaps; I am however of opinion, that ſuch obſervations if made with preciſion and veracity, are extremely intereſting and uſeful, ſince they eſtabliſh not only rules for particular mountains, veins and mines, but may in time lead to a nearer knowledge of the hitherto too myſterious chemical preparations of nature.

I have

I have ſaid that in the *Kaff-mountain* iron and tin is dug in the ſame pit and in the ſame vein. The iron here generally appears in its upper part; the tin, which is here extremely irony, conſtantly appears at a greater depth; and it would be worth while to examine whether ſilver-ore might not be found in a ſtill greater depth, which might be eaſily done by a gallery. My conjecture is ſupported by a general obſervation in the neighbouring *Saxonian* rich ſilver mines. The ſame vein contains there under the turf iron, in a middle depth tin, and at the greateſt depth ſilver; and this ſeems to be owing to the ſame cauſe, which in any point of theſe veins, if arſenical, has produced ſilver whenever, as I told before, an irony vein comes a croſs or unites with them. Having already declared my opinion on the importance of this obſervation and its conſequences, and being far from inclining to alchymiſtical fancies, I hope not to be aſked for a natural ſolution of this phænomenon. I declare freely to be as ignorant of the cauſes as I ſhould like to know them; what I know of the matter is, that this phænomenon is fact in the *Saxonian* metallic mountains. It is not I alone who have been convinced of it by ſeveral obſervations; ſome of the moſt learned miners can atteſt it, and have convinced me of it by many examples. Nay in *Saxony* they make uſe of this and other ſuch obſervations, and apply them

them with ſucceſs to a ſcientifical and practical working of their mines; and even the annaliſts of the *Saxonian* mining places, but ſtill more ſo the ancient records, prove that ſeveral *Saxonian* mines, at preſent producing ſilver, yielded in former times, and in their upper drifts, good tin-and iron-ore. Mr. *Peithner*, who before his preſent preferment to the character of counſellor, taught at *Prague* the ſcience of mines, has found the ſame obſervation ſupported by ſeveral correſponding ones in *Bohemia*. I have peruſed ſome parts of his lectures, as penned down by one of his diſciples, and in theſe I find the following paſſage: " Some of our *Bohemian* mountains, " ſuch as thoſe at *Platten*, *Neudeck*, *Gottes Gab*, and " above the *golden-top*, near the new road to *Berin-* " *ger*, and ſome others, conſiſt in their upper parts " and drifts of iron flats or beds," (which as I have already noticed is a miſtake of flat and ſoaring veins) " but in a greater depth they are fol- " lowed by rich tin, nay even by ſilver-ore."

I return to the mines in *Kaff*. Pyrites here quickens the tin-ore. The tin-ore, after a previous roaſting, is pounded and waſhed on hearths, in which operation they make uſe of the loadſtone in order to ſeparate the iron. Though all the iron particles cannot be drawn off by the loadſtone, they are however raiſed by it, and the eaſier waſhed down.

Formerly

Formerly there have been near *Gottes Gab* ſilver mines, which are ſaid to have produced a dark red ſilver-ore, hereabout called native brown-ore.

Bleyſtadt, *in the Circle of* Saaz.

THE mountains conſiſt of grey micaceous quartzous and argillaceous ſlate, which in a mine called *Heerzug* contains red garnets. The richeſt veins run from the weſt; the northerly veins are deaf and cruſh the former. The rock filling the weſtern or eaſtern veins conſiſts of quartz, which they call *gneiſs*, and appears under a ſound and compact or a looſe and a farinaceous form.

Their dipping is generally vertical, and their width is from three to eight feet. They are ſteady to a depth of 160 fathoms, till the quartz turns deaf and unmetallic. The ore is coarſe glance, and now and then white lead-ore and brown and reddiſh lead-clay. Formerly there was likewiſe green lead-ore. The glance containing ſcarce any ſilver, they pound and ſell it either as lead to the furnaces at *Joachimſthal*, or to the potters for glazing.

Schlackenwald,

Schlackenwald, *in the Circle of* Saaz.

THE country is rather gently aſcending than mountainous; accordingly they till and plow the ſoil which covers the deeper rocks. Theſe conſiſt of a mixture of quartz, glimmer, and white clay, which ſplits into lamellæ, and forms gneiſs, or a continuation and variety of the *Bohemian* argillaceous metallic mountains. They have here three different ſorts of veins. 1. *Lead-veins* with ſilver; and particularly a quartz vein in the Emperor *Joſeph's* gallery, running in hour eight.

2. *Tin veins*, ſuch as thoſe in the croſs mine, which produces wolfram, copper pyrites, tin ore, and tin zwitter in quartz.

3. *Tin ſtocks.* In ſome mineralogical accounts, the name of ſtock-works is too often miſ-applied to the uniting of ſeveral veins in the ſame run, or to the larger bellies of ſingle veins. In either of theſe caſes there is no reaſon, why the name of vein ſhould be given up for that of a ſtock-work. I underſtand by *ſtock-work*, that native place of metals, which without any regular or determined run to any certain point or line of the compaſs, and without any determined dip-

ping

ping, appears rather as a large conical body of rocks, ſunk or inſerted in the midſt of a mountain. Such a cone or lump conſiſts either of pure ore or of a rock, which is more or leſs impregnated and penetrated with metallic particles, and is conſtantly of a different kind than the ſurrounding or including rock. The whole ſtock is included within a curve line, which may be either an oval or a circular one. Theſe circular out-lines either unite as commonly in the depth or they diverge. In the firſt caſe the ſtock has the form of an inverted cone; in this it hath the form of a truncated and ſtanding cone. Three ſuch ſtocks have been hitherto obſerved at *Schlackenwald*, 1. The *Royal Huber*, which is the largeſt, and ſtill working. 2. The *Stock-ſhaft*, ſmaller and worked out. 3. A *Stock* not yet examined, but reputed to be of the ſame circumference as the ſecond. Their natural condition being the ſame, as far as hitherto obſerved, I ſhall confine myſelf to the deſcription of the *Royal Huber*.

The rock which ſurrounds it, or in which it is ſtanding, is *gneiſs*. The ſtock itſelf conſiſts of granite, or a mixture of quartz, feldſpath and mica-grains and lamellæ, more or leſs penetrated and ſprinkled with tin-ore.

The feldſpath is reddiſh or grey; but often in its place appears a white and greeniſh clay, which probably

probably might have turned into feldſpath, as a decay or mouldering in the midſt of the rock and under ground cannot be properly ſuppoſed. This laſt variety of granite, which is commonly the leaſt rich of tin, is at *Schlackenwald* called *grit* (*greiſs*) and its conſtituent parts, quartz, mica and clay ſeem to indicate, that it is but a variety of the gneiſs, which ſurrounds the ſtock. In a mineralogical reſpect that aſſertion is pretty true; and the difference of the rocks being lamellous and of the grits appearing in a compact form, is of no importance. However, this difference is very remarkable and intereſting in reſpect of their origin, antiquity and ſituation.

This grit-ſtone conſiſts of grains and lamellæ, ferruminated together as the pebbles in a pudding ſtone. Whatever be its origin, it is in reſpect of the time and the manner, in which it happened, of courſe different from that revolution, in which ſimilar conſtituent parts joined into an uniform, not granulated more compact rock, which is lamellous, and goes under the name of gneiſs. Moreover it breaks in with the granite of the ſtock, without any remarkable ſeparation or bedding; it never occurs in the including gneiſs. Accordingly it is a variety of the granite, and is produced with it in the ſtock, in the ſame moment and by the ſame revolution.

The

The granite of this ſtock is comparatively with the common metallic mountains to be conſidered as the vein; the ſurrounding gneiſs is in the ſame reſpect to be compared with country rock. But here the queſtion ariſes: whether this ſtock, like other veins and fiſſures, be produced after, and in its præ-exiſting mountain-rock? Or whether this granite-ſtock may be conſidered as a top or ſummit of the ancient primitive and deeper granite, which was afterwards ſurrounded, incloſed and covered by the more modern gneiſs? Being convinced by many facts that granite is a more ancient and deeper rock than argillaceous ſlate, gneiſs and other ſuch varieties; having moreover ſeen many inſtances of the granites high and bare appearing through and above the more modern and incumbent rocks, I am rather inclined to this laſt opinion.

1. Becauſe the common theory of the origin of veins by fiſſures or cracks produced in the mountain-rocks, when firſt they began to dry, does not account for round conical holes in the mountain-rocks, of ſuch extent and regular form as the ſtocks under conſideration.

2. Becauſe even allowing ſuch conical holes there remains the difficulty, how they might have been afterwards filled up with granite, which commonly

commonly is not found as vein-rock, except in its own fiſſures.

However, to wave the charge of being too much prejudiced for my hypotheſis, I leave my conjectures of the origin and antiquity of this granite-ſtock and its ſurrounding gneiſs-mountain, to the conſideration of the intelligent reader. Nay, in ſupport of thoſe, who might be inclined to conſider this granite ſtock as being of more modern date and produced in the more ancient gneiſs, I will candidly relate, that the *Royal Huber Granite-ſtock* in its upper part is 100, but in the depth only 92 fathoms diameter, having the form of an inverted cone, and being for that the more reſembling to the metallic veins, which diminiſh to the depth, and at laſt diſappear entirely.

But there is beſides a third poſſibility; that of the granite ſtocks and gneiſs-rocks being produced at the ſame time. Of all the before-mentioned this is indeed the leaſt probable.

Whatever hypotheſis my readers ſhould have a mind to, they will obſerve that no concluſion can be drawn from them againſt the general obſervation, that the granite in the largeſt and higheſt *European* mountains is more ancient than argillaceous ſlate and gneiſs; and that theſe are incumbent on granite, as limeſtone and other modern beds are accumulated on them. Though by my own

own, and ſo many other obſervations, I am convinced of that, I cannot deny to nature the power of producing under proper circumſtances the ſame ſpecies of granite or rock, which it produced in former times, either by water or by fire, as appears by ſome lava's which exactly reſemble the granitello's. It is obvious that I meant not to ſpeak of theſe ſuppoſed modern granites, but of the ancient ones, in which we can be the leſs miſtaken, as nature in its preſent quiet courſe, and without ſome new and great revolution in our globe, is not likely to produce any remarkable granite rocks, or any far-ſtretching, high-towering chain of ſuch mountains. The argillaceous ſlate of the chief, middle and richer, metallic mountains in *Europe* is, in a mineralogical reſpect, the ſame as that ſlate, which is bedded in the more modern mountains; nay which is every day produced by the ooze of every muddy lake; however, it would be extremely wrong to confound them in a Natural Hiſtory of the Earth, in the ſame manner as they are confounded in a Syllabus of Mineralogy. Similar beds of clay or other ſtratified ſtones, or different only by accidental circumſtances, ſuch as that of colour or hardneſs, or mixture of iron, lime or phlogiſton, are very often found in different depths and ſeparated by other ſtrata. A mere mineralogiſt or collector of foſſils would

rank the produce of these different beds in the same class, nor think of any difference; but the historian of subterranean geography cannot fail to observe their differences in respect of their antiquity, origin, relation to other beds, metallic contents, and influence on the crossing veins. The fine-grained limestone of the *Alps*, the scaly or saline limestone, the calcareous tophus or travertine, the limestone incumbent on coals, and finally that species, which we see every day on the *Dutch* shore, produced by sea shells, are lime, nay some of these different species agree in the manner of their origin; though in general they are different in this and in many other respects. A common systematical collector will unconcernedly break the flints from their chalk-matrix, in which they are found in *France*, in *England*, and in *Stevens-Klint* on *Seeland*, and most systematically rank the flints with the other silices, and the chalk with the calcareous earths; but a scientifical naturalist draws from these native places, and other concomitant circumstances, conclusions on the origin of the flints. The former examples illustrate what I have said of the granite and its varieties; and the latter demonstrate the necessity and use of a nice observation of the different native places of fossils.

I re-

I return to *Schlackenwald*. The mixture of the granite is not uniform throughout the maſs of the whole ſtock. Sometimes large ſtripes of pure quartz are contained in it, and theſe are remarkably rich of tin-ore, with blue and green fluors, of wolfram, ſome copper-pyrites and black-lead (*molybdæna.*) In other places the mica is accumulated in large laminæ; in others prevails the feldſpath, or, inſtead of that, a white fat clay. Though the whole ſtock be throughout ſprinkled with tin-ore, it is however more frequent and more accumulated in the parallel ſtripes, which croſs the finer grey or reddiſh granite.

Some deaf fiſſures or veins croſs the ſtock commonly in hour three. The ancients made uſe of them in their works, eſpecially for firing the ore. One vein, called the *Tſcherpermaas-Vein*, croſſes our granite ſtock in hour twelve, and contains tin-ore, pyrites and wolfram in quartz. I am ignorant, whether theſe veins have their conſtant run beyond the granite-ſtock in the gneiſs, a circumſtance which is obſerved in the tin-ſtock at *Geyer* in *Saxony*, and might be ſuppoſed perhaps in this, as they are found agreeing in ſo many other circumſtances. I am equally ignorant whether this granite-ſtock, as that at *Geyer*, have a ſkirt or incloſure (ſtockſcheider) which in that place conſiſts of feldſpath, ſometimes mixed with

quartz, mica or clay. The tin-ſtock at *Altenberg* in *Saxony* is of a different nature, ſince incloſed in granite, and conſiſting of a variety of granite, in which the quartzous particles are prevailing.

The mines at *Schlackenwald* are ſaid to have been working above 530 years. The *Royal Huber* was formerly held by grant by ſeveral companies, who worked this ſtock in common with the Empreſs-queen; but hence aroſe very irregular works, which in this place are of old ſtanding, ſince the upper fields or levels, having been worked out without any reſpect to after-times gave way before the year 1580, and cauſed a large gaping fiſſure, which is ſtill to be ſeen. However, they went on again with the ſame irregularity in the under levels, which are ſaid to be above 100 fathoms under ground. The conſequence is, that even at preſent the works cannot be ſafely examined, and that any jumping on the turf above the works makes the whole ground tremble and ſhake. Some time after the ocular examination of theſe mines by Baron *Mitroffky*, which happened in the year 1743, her Royal and Imperial Majeſty has recalled and redeemed the grants, but to no great advantage, ſince after the irregular ravages of the old man, which have crippled the whole ſtock, it is almoſt impoſſible to introduce any regular work beſides, and the richer and larger

tin-

tin-ore cryſtals of former times ſeem to be gone. Formerly they had here that ſcarce ſpecies of ore, which is known under the name of white tin-ore.

Beyer in otiis metallicis, Part. III. p. 169, has given an account of the preparing, uſtulating, waſhing and ſmelting of theſe and other tin-ores.

To encourage and to facilitate the *Bohemian* tin-mines in general, her Majeſty has ordered her mineral trade commiſſion at *Vienna* to buy the *Bohemian* tin at a certain fixed price.

The tin-ores of *Schlackenwald*, *Platte*, *Gotteſgab* and of many *Bohemian* waſh-works, were formerly ſuppoſed to be auriferous, and to contain ſome ſilver. But modern aſſays have proved the contrary.

Schonfeld, *near* Schlackenwald.

THE tin mines in this place are the moſt ancient in *Bohemia*. Of the former ſilver mines nothing is remaining but ancient records. The *Simon Judas* and the *Croſs* mine have been the richeſt tin-mines, and were worked on veins which ran in *gneiſs*. The white tin-ore, which

Cronſtedt, §. 2. 209, has called *ferrum calciforme terra quadam incognita intime mixtum*, was found in theſe mines. It offers either compact in indeterminate forms, in which caſe it reſembles to ponderous white or greeniſh and fat quartz, or in white or yellow ſplendent cryſtalliſations.

Græſlitz, *in the Circle of* Saaz.

HAS yellow and greeniſh copper-pyrites, with green and brown copper ochres in argillaceous and quartzous ſlate. In the ſmelting of theſe pyrites nothing is remarkable, except that they make uſe of white fluor, fetched from *Saxony*, and that to ſome ſoft pyrites they mix limeſtone.

Mies, *in the Circle of* Pilſen.

THE mountains conſiſt of grey micaceous and argillaceous ſlate, ſometimes mixed with quartz. The veins are generally quartz, which now and then is cryſtalliſed. In a ſpecies of theſe cryſtalliſations I obſerved the ſame parallel inciſions

ciſions, which are a character of the cryſtalliſations from *Hodriz* near *Shemniz* in *Lower Hungary*. The ore is lead glance, which per hundred weight yields from two to four ounces of ſilver, and towards forty pounds of lead. Yellowiſh green hexagonal priſmatic lead ſpar has been found in former times. The works are in great decline, and have ever been very ill contrived, which makes their examination not only difficult but dangerous too.

The coal work near Wilkiſhen *in the Circle of* Pilſen.

IT is but of late that in this place a gallery has been driven into a coal-bed, which baſſets out; and they have but juſt begun to ſink a ſhaft upon it. If I were only to write for thoſe who in the art and ſcience of the mines ſee and conceive no further entertainment than as far as they have a proſpect of clear gain before them; and if I were not convinced too, that exact mineralogical obſervations, even of poor mines, may prove very uſeful for richer ones, I might have very juſtly ſuppreſſed what I ſhall have to ſay of this inconſiderable coal-work and its ſituation. But as thoſe gentlemen will not poſſibly looſe their time with my

performances, I ſhall rather freely ſubmit my obſervations to the judgment of the few learned connoiſſeurs.

The mountains, which to the weſt divide *Bohemia* from the *Upper-Palatinate* and *Bavaria*, conſiſt of granite and of ſeveral varieties of argillaceous ſlate. The granite of the higheſt mountains hereabout contains large and thick black ſherl-cryſtals. In my deſcriptions of the mines at *Catharinaberg* I have given already ſome account of the rocks of theſe mountains, which connect with the Circle of *Pilſen*, and to the ſouth run into the Circle of *Prachin*, and to the north into that of *Saaz*. In order to determine the ſituation of the coal-bed at *Wilkiſhen*, I am to fix upon a point of this ridge of mountains, and that ſhall be at *Kladraw*, one hour's way diſtant from *Wilkiſhen*.

The mountains in this place conſiſt of pure ſometimes micaceous and more or leſs quartzous dark grey or blueiſh argillaceous ſlate. *

* If a great quantity of quartz be cloſely blended and connected with argillaceous ſlate, it proves very hard and longitudinally fibrous in the fractures; that is to ſay, it changes into true *horn ſlate*. *Corneus Fiſſilis Wallerii Mineral*, Ed. 2. p. 358. 2. I have been convinced at *Kladraw* of this degeneration. Pure argillaceous ſlate is commonly croſſed by quartz veins. Horn ſlate has no ſuch veins, but inſtead of them quartz has internally and equally connected itſelf with the clay and its produce the mica. It is found here in the

On the road between *Kladraw* and *Haide*, and towards *Pilſen* fragments of this ſlate are found, ſome of them regular cubes, others in the form of oblique or rhomboidal pyramidal columns, from ſome inches to one foot in height; their form as the cryſtal, n. 8. tab. I. in *Linne's Syſtema Naturæ*, tom. III. In the granite mountains, near *Kladraw*, I have found ſimilar rhomboidal and pyramidal columns of grey and reddiſh granite. Their form is conſtant and regular; in

the ſame horizontal or ſoaring ſituation as the common pure argillaceous ſlate; accordingly it is not conſtantly in a vertical poſition, as at *Edelfors* or in other metallic mountains; nor does it appear in the form of waves. It may be doubted therefore with great propriety, whether that vertical poſition hath been its natural poſition from its very beginning. Moreover the poſition, which may be accidental, does not determine the ſpecies; the leſs ſo as even the pureſt argillaceous ſlate, nay many other modern ſtratified ſtone beds appear not only in horizontal and ſoaring, but likewiſe in many other, and even in vertical poſitions. All theſe circumſtances, together with the chemical aſſays, prove it to be argillaceous (*Wallerii Mineralogy*. ed. 2, p. 355, 358, 359, and 364.) and convince me, that it ſhould not be conſidered as a genus, but that it might be very juſtly ranked with the common argillaceous ſlate (*Schiſtus Wallerii.*) However, as it is a variety, I do not controvert its proper name and claſſification in the Mineralogical Syſtems; but in reſpect to phyſical geography it ſhould ever be ſeparated from the argillaceous ſlate.

ſome

ſome of them the feldſpath, in ſome others the quartz is decayed into farinaceous clay.

But a third ſpecies of columns of the ſame form is to be found about *Kladraw*; and this conſiſts of a variety of the dark grey argillaceous ſlate, which ſeems to be an intermediate ſubſtance between argillaceous ſlate and granite. Its ſubſtance is darkgrey, blackiſh and fine micaceous ſlate; but it is mixed with parallelopiped ſpots of white and lamellous feldſpath, which expoſed to the air turn milky and opaque. By this accident it reſembles to porphyry or to a variety of granite. Near *Plan* red garnets are found in it, which proves its being a variety of argillaceous ſlate, becauſe the *Bohemian* garnets are commonly in micaceous quartzous clay ſlate. Perhaps the rock, I am ſpeaking of, is breaking in the limits where ſlate and granite border together. It is in my opinion a remarkable phænomenon, that this variety of argillaceous ſlate with ſpots of feldſpath, nay even the pure argillaceous ſlate and granite are found in theſe parts in conſtant determined and regular columnar forms; and as they are found ſo in their natural ſituation in the mountains, it appears clearly that theſe rocks in their former ſtate of fluidity had a natural tendency to a regular form whatever be the cauſe of it.

The

The regularity of their faces and angles would induce me to conſider their forms as cryſtalliſations; but as commonly the name of cryſtalliſations is given only to regular aggregations of diſſolved ſaline and metallic bodies, I leave to my readers the liberty to look out for a better name. It is fact, that theſe rocks ſplit and break with as much regularity as poſſibly may be produced by any cryſtalliſation. How it happens, that ſo few granite and ſlate-rocks, and thoſe but in certain places, are endowed with that quality, I am at a loſs to account for. ||

In the neighbourhood of *Kladraw* is another variety of argillaceous ſlate. It is cloſely mixed with quartz and mica; is extremely ſhivery and a true table-ſlate (ardeſia) for which reaſon they break and uſe it inſtead of tiles. The convent at *Kladraw* is covered with it; and I ſuppoſe it is a fair concluſion that this table-ſlate (ardeſia) is not conſtantly found in modern or flat-mountains (flozberge.)

|| Let us fairly confeſs that we are equally ignorant of the natural cauſes of the ſaline and metallic cryſtalliſations; and that beſides the above-mentioned rocks and ſtones there are many more, which break into regular forms, though theſe have not been hitherto properly attended to by our Mineralogiſts. I gave a hint of that kind in the firſt *Latin* edition of my Syſtem of the Earth, p. 11, 12, 13.

The

The coal-work at *Wilkiſhen* is but one hour's way diſtant from *Kladraw*, and the road is thence conſtantly deſcending. In the adjacent fields, and ſcarce a gunſhot diſtant, many grey granite blocks appear above the vegetable mould. I could not diſtinguiſh whether theſe blocks were detached pieces, or parts of the granite-rocks under ground; but it is fact, that the coal-bed, with its ſkirts of black and rotten ſlate, is but from three to ſix fathom under the turf. Its roof or cover conſiſts of a mixture of white-grey clay, ſome quartz-grains and ſome flakes of argentine white mica; that is to ſay, it conſiſts of a looſe incoherent granite, which on that account rather deſerves the name of ſand, and in fact is called ſo by the workmen. The queſtion: whence it was produced? is eaſily anſwered by the above deſcription of the higher mountains near *Kladraw*; and that roof may juſtly be conſidered as grit and decays of the ſchiſtous and granite mountains, waſhed down and ſucceſſively accumulated upon the coal-bed. But what is the coal-bed in itſelf? I ſay, it is the continuation of the argillaceous ſlate at *Kladraw*, penetrated in this by petroleum; accordingly it is not, as commonly, a modern flat, accumulated on the primitive mountain rock at *Kladraw*, but it is a part

a part and a continuation of that very primitive mountain. §

Some of my readers will, I am confident, find this aſſertion at variance with the common opinion, according to which coal-beds are generally conſidered as conſtantly belonging to the modern accumulated flats (flozberge) and as never making part of the more ſimple ancient or primitive mountains; but as coals are argillaceous ſlate penetrated with petroleum, ¶ I ſee no reaſon why

§ Though the continual ſloping deſcent of the primitive ground from *Kladraw* to *Wilkiſhen* be favourable to this hypotheſis, it wants nevertheleſs better evidence, as on that ſloping primitive ground modern beds might have been accumulated by the ſame revolutions, which have accumulated ſo many others.

However it would be very unfair to deny the poſſibility and ingenuity of the hypotheſis, ſtubbornly to aſſert with ſome Mineralogiſts againſt facts and reaſon, 1. that coalbeds are conſtantly to be conſidered as the remains of ancient foreſts, and 2. that they are conſtantly covered with and accumulated on modern ſtrata. That aſſertion may be ſupported by partial and local obſervations; but they can never make good a general aſſertion as will appear in the ſequel.

¶ Many coal-beds conſiſt viſibly of remains of trees, plants and foreſts, more or leſs bituminous, and more or leſs affected and changed by the ſituation in which ancient revolutions have left and brought them.

Theſe are out of queſtion here. Mr. *Ferber* might however have taken ſome notice of them, by telling, that beſides theſe coal-beds, there are ſome others, which are undoubtedly conſiſting of bituminous argillaceous modern ſlate. It would not have hurt his hypotheſis.

nature

nature ſhould not ſaturate with the ſame ſubſtance any argillaceous ſlate, whether it be of an ancient or a more modern origin; and I am the more of this opinion, as we are far from being convinced that petroleum is only to be found in modern beds. The diſtinction between the modern flats and the pretended primitive mountains is leſs material than is commonly ſuppoſed. It merely relates to their different antiquity; for the argillaceous ſlate of the pretended primitive mountains is as well accumulated on granite as every other modern bed is accumulated either on granite or other rocks; and whether this accumulation arrived in the beginning of the world, or long after, is an object of mere conjecture. The different width of the ſtrata is of no greater importance. The pretended primitive mountains are moreover called *Gang* or *Vein*-mountains, becauſe metallic veins are generally found in them; and as theſe have been formerly working at *Kladraw* there is no doubt, that the mountains hereabout are juſtly to be conſidered as primitive or gang-mountains; However, this circumſtance alone would not make good the aſſertion, ſince metallic veins are likewiſe found in modern ſtratified flats; for example the cobolt-work in *Saxe-Saalfield*; the lead-works in *Derbyſhire*, and in many other places; for hence it naturally follows, that the mountains

tains produced by water, or by aqueous ſolution, in reſpect of the different periods of their origin and accumulation, and on no other account, can be with propriety divided into old and modern ones, owing their origin to different degrees of relative antiquity. The *ancient-mountains* might, in compariſon to the modern incumbent ones, and their greater variety of thin ſtrata, be called with greater propriety *ſimple-mountains*. Their denomination of primitive, original, or gang-mountains is by no means characteriſtic.

I am to obviate here an objection, which probably will be made to me by thoſe who are acquainted with the country between *Kladraw* and *Wilkiſhen*, and between *Pilſen* and *Prague*. It is in general flat, and immediately behind *Kladraw* the mountains ſlope into a plain, which conſiſts of clay and loam, and afterwards of coal, lime, and other depoſited aqueous modern ſtrata. Accordingly this whole tract of land ſeems to be covered by modern beds, beginning at *Wilkſhen*. But I cannot allow that aſſertion in reſpect to the place I am treating of, ſince the coal-works at *Wilkiſhen* are not in the plain, but in the ſloping of the higher ancient mountains. Beſides, the coals are immediately under the turf, being covered only by looſe grit and decays of the higher mountains, and deſtitute of any regular roof of lime

lime or marle. I had no opportunity to examine the coal-works at *Kotteſhaw*, which are but one hour's ride diſtant; but I am aſſured for the reſt that the whole tract of land hence to *Pilſen* and *Prague* is generally flat and ſtratified, containing ſome coal-beds near *Pilſen*, *Shabrach*, *Berawn*, and limeſtone beds at *Stiez*, which are covered by greyiſh yellow clay. Probably the brooks at *Pilſen* and *Berawn* were larger in former times, and may be ſuppoſed to have depoſited theſe different beds. The ancient mountains behind *Kladraw* however, which conſiſt of argillaceous ſlate and granite, continue uninterruptedly running under ground; for they appear above ground in ſeveral places between *Kladraw*, *Pilſen* and *Prague*. The grey granite-rocks appear on the road from *Kladraw* to *Pilſen*; and thence to *Prague* the argillaceous ſlate, which is either pure, or micaceous, or a horn-ſchiſtus. All this together coincides to ſhew that the coals at *Wilkiſhen* may belong to the more ancient mountains, which are found running under ground far beyond this place. Even ſo far as *Prague* are obſerved ſome ſchiſtous mountains, which riſe high above the ground. The other mountains thereabout are calcareous, and contain petrifactions; ſo that the common coal-beds at *Shabrach*, and the different ſtrata of marle and clay, which are found between the prominent

nent rocks of argillaceous ſlate, may be juſtly aſcribed to one or to different inundations. The grey-yellow vegetable mould between *Kladraw* and *Prague* is for the greater part owing to inundations; however it is partly produced by the decays of the argillaceous and micaceous ſlate-gneiſs and hornſtone-rocks, which appear above the ground; and this is evident from the mica flakes, which are found in it.

The concluſion, which I am to draw from this, is, that coals are not conſtantly found in the modern flats, but that ancient (pretended primitive) argillaceous ſlate is likewiſe now and then ſaturated and penetrated by petroleum. This may be probably obſerved in many other places. Should it not perhaps be the caſe of the coal-works in the high and ſhaggy mountains of the *Habichwald* near *Caſſel* in *Heſſe*? † There are ſeveral others, which

† For this I refer the reader to my late account of the *German* volcanos, by which it will appear, that this large and ſhaggy mountain is produced by many ſucceſſive ancient volcanic eruptions, and cannot by any means be ranked among thoſe ancient granite-or ſhiſtous-metallic-mountains, which Mr. *Ferber* is ſpeaking of. However, as I have no objection againſt his hypotheſis, and am rather inclined to agree with him, I ſhall liſten to his call on the naturaliſts, and by laying down in a few words, what I know by my own obſerva-

which I ſuſpect to be of the ſame nature. However, I wiſh, that intelligent naturaliſts might examine this my adventurous opinion, compare it with nature, and confirm or refute it by exact obſervations. It is of ſome importance to the naturaliſt, nay even to the miner, ſince it accounts and will account not only for the horizontal and ſoaring, but likewiſe for the vertical ſituation of coals. *Zinnwald*

tion of the coal-mine on the *Habichwald*, not only make a ſupplement to the above deſcription, but likewiſe to Mr. *Ferber's* aſſertion.

On the higheſt ſummit of the *Habichwald*, which conſiſts of alternating and various beds and rocks of volcanic aſhes, lavas, cinders and tufo, accumulated on more ancient lime and ſandſtone, there is (beſides a ſpacious plain behind the octogon,) towards *Hof*, a gently ſloping ground, which falls or runs down into the *Druſelthal*. In the midſt of this ground riſes a hill, which is called the Zigenberg, and is incumbent on the lower coal-bed, which has been worked in many directions, and as it ſhould ſeem, ſurrounds it on every ſide.

The ſtrata in this coal-mine are, 1. Immediately under the turf, black vegetable mould, mixed with decays of the ſurrounding volcanic hills, that is to ſay, with fragments of hard lava and tufo; three feet.

2. White fine quick ſand, as found on the other ſide of the *Druſelthal*, and the hill behind the *Pauls-harmitage*, under many tufo and lava beds, in an ancient pit and gallery, called the *ſilver-well*, and behind the *Sneckenberg* in a ſand-pit immediately ſurrounded with volcanic materials, but not capt with them. One fathom three feet.

3. White

Zinnwald *in the Circle of* Leitmeriz.

THE mines in this place are but ſlowly working, if working at all. The country or the mountain-rock is granite of a different mixture. Some large *ſoaring-veins*, which very improperly

3. White fine clay, as found likewiſe under the above ſand pit; and under a ſtratum of baſaltes behind the great water ſpout in the garden at *Weiſſenſtine*; three fathoms.

Digging in this clay bed to the depth of three fathoms, it begins firſt to turn grey by ſtripes and afterwards entirely black, till it degenerates into coals; which is viſibly owing to its greater or leſſer ſaturation with petroleum.

4. Coals, having in this mine no roof, as being immediately connected with their ſubſtantial earth, the above clay; three fathom three feet.

The clay penetrated with petroleum, or the uppermoſt imperfect coal, is in ſome places looſe, and a ſpecies of blackiſh or browniſh ruble or rotten-ſtone, which being an excellent brown or blackiſh painters clay, was formerly ſold under the name of *Painters clay* from *Caſſel*, till the painter *Huchfeld* died who dealt in it, and had kept its native place a ſecret. I have found it again, not only in the coal-mine, but likewiſe immediately under the above ſand pit behind the *Snekenberg*, whence the painter *Huchfeld* is ſaid to have dug it.

Towards the ſole the coals turn harder and richer, being then more bituminous and more like the *Scotch* coal; which again proves the former preſence of fluid petroleum.

improperly they call flats run in it, and theſe are variouſly cut off, compreſſed and altered in their direction by other vertical ones; in which caſe they are purſued and found out again by the ſmall metallic or argillaceous joints, which to the *German* miners are known under the name of *Schleppungen*,

5. The ſole of the coals is white ſand rock, extremely hard, and ſtriking fire with ſteel. As hitherto no pit has beeen ſunk through this rock, I cannot tell on what ground it is incumbent, whether on volcanic maſſes, which in reſpect of the high ſituation of the coal-mine on the ſummit of the *Habichwald* is probable, or on limeſtone, which ſeems to be the caſe in reſpect of the ſimilar ſandſtone rocks, found on the other ſide of the *Druſelthal* near the caſtle of *Weiſſenſtein*, which is in a lower ſituation than any volcanic ſtratum of the *Habichwald*.

From theſe facts I draw the concluſions, 1. that coals are not conſtantly found in any regular order of ſucceſſive ſtrata, nor conſtantly under a roof; 2. that being in this place viſibly produced from clay, ſaturated by petroleum, they may be found in any place or ſituation where clay or argillaceous ſlate is to be met with, in ancient ſimple or modern ſtratified mountains, as well as on and in volcanic mountains; and 3. that henceforth coals will not be conſidered as conſtantly produced from trees, plants and foreſts, buried by inundations, though many coal-mines have had ſuch an origin.

I cannot conclude this account without taking notice of ſome ſpungy coals, which occur now and then in the coal-bed

Schleppungen, and have been deſcribed by Baron *Swab* in the *Swediſh* Tranſactions, or in his account of the gold-veins at *Edelfors*. The rock of the ſoaring veins conſiſts of various mixed granite, quartz partly cryſtalliſed, tin ore, blue, green and yellow fluor, pyrites and verdegreaſe. They appear often on both ſides incloſed by *ſaalbands* or ſkirts of lamellated cat-gold of ſome inches thickneſs.

bed on the *Habichwald*. They are found by nodules within the ſound coal-bed; are extremely light, and reſemble the ſcorified ſpungy lava's, found near the octogon on the *Habichwald*. They cannot poſſibly be conſidered as cinders or as coals conſumed by fire; ſince there is no reaſon why they ſhould have been burnt out, and why their heat or fire ſhould not have catched the combuſtible matrix of ſound coals, in which they are contained.

If I were allowed to ſuppoſe that the clay-bed on the *Habichwald* was produced, as thoſe in the *Solfatara*, from volcanic aſhes, changed by ſulphurous acid into clay, there would be leſs difficulty to account for theſe ſpungy honey-combed coals; ſince then they might be juſtly conſidered as ſpungy volcanic cinders or conſumed lavas, together with the volcanic aſhes, firſt changed into clay by ſulphurous acid, and afterwards changed into coals by fluid petroleum. Though I am inclined to think ſo, I leave it however to the nearer examination of thoſe, who are qualified for the taſk, and who will greatly oblige the Mineralogiſts by making out, whether any coals are found under the volcanic ſtrata of the *Habichwald*, which, if ſo, would greatly alter the hypotheſis; but it never has appeared ſo to me. *(Tranſl.)*

Topliz, *in the Circle of* Leitmeriz.

THE mountains from the above place to this, by the way of the *Oak-foreſt*, conſiſt of granite; and the ground is continually ſloping towards *Toplitz*, till at once it ſinks abruptly into the plain.

The country about *Toplitz* conſiſts of gentle *accumulated modern mountains* of clay, lime and coals. It is interrupted by ſome ſteep inſulated higher mountains, which are calcareous, and ſeem to be detached parts of the lower and gentler flats, raiſed by ſome violent accident. This affords an excellent opportunity to diſtinguiſh the difference of the modern incumbent and the more ancient ſimpler mountains, and to obſerve how the former have been accumulated on the latter, when their vallies were large reſervoirs of water, in which their ſeveral ſediments were ſucceſſively depoſited.

The *hot wells* and the *bath* at *Toplitz* are objects too much and too generally known, to want any deſcription of mine. The bath-water has a ſtrong ſmell of *hepar ſulphuris*. They tell here that, at the time of the earthquake at *Liſbon*, theſe

theſe wells, together with thoſe at *Carlsbad*, decreaſed, and then burſt out with great violence; whence they deduce ſubterraneous canals, reaching as far as *Portugal*. But the great diſtance ſeems not to be favourable to ſuch a ſuppoſition; and a ſimilarity of cauſes may have produced theſe phænomena in the ſame moment of time. Next to the town riſes a large limeſtone ſtratum, and cloſe by are loam pits, worked for kilns. Near the foreſt-gate is a coal-bed, covered with ſome fathoms of clay, which partly is fullers clay, and commonly contains lumps of cryſtalliſed pyrites. Immediately under this ſtratum is a ſtratum of wood-coals, or foſſil-wood, ſome inches thick; and then the coal-bed, which appears four fathoms above ground, and has not been hitherto explored in its whole width. It conſiſts of ſhivery coals, and many thin beds of clay, from five to eight inches thick. There are no regular works, the coals being dug as from a quarry. The ſhivery rubbiſh is burnt, and the aſhes produced ſold as manure or dung to the farmers.

Graupen.

THE road from *Topliz* to *Maria-ſchein* runs over gentle and low hills of clay and lime. The detached granite, which now and then occurs, comes from the mountains on the other ſide of *Toplitz*. Near *Maria-ſchein* ſuddenly riſes a large chain of high and ſteep mountains of gneiſs, which include the baſon on this ſide of *Toplitz*. *Graupen*, a tin-place, is at the foot of theſe mountains, which are called the *Knutler Gezirck*. Aſcending theſe ſteep mountains I obſerved an old vein, worked out up to the turf; but found no remains of old bing-places. Two ſilver-veins, belonging to the community of *Graupen*, are ſtill working; one called *S. Nepomuc*, the other *Silver-beech*, which proves alſo in this place, that gneiſs is generally a matrix of ſilver-veins, though here it likewiſe contains tin-veins, which commonly run in granite, and are then not interrupted. By means of a ſhaft ſunk on a vein, they had diſcovered others, which unite at a ſmall depth, and all of them are metallic. They might, by a draining level of two hundred fathoms, clear them to a conſiderable depth; and to judge of the bing-places

places and the ores, which I found there, it would be worth their while. I obſerved,

1. Sound lead glance with pyrites, and black jack in quartz.

2. The ſame with yellow blende.

3. Lead glance, blende and tin-ore in quartz.

4. Sound tin-ore and lead-glance in tin-ſtone.

5. Large pieces of cryſtallized tin-ore and blende.

6 Fluor with copper-green and azure.

The mixture of leadglance and yellow blende make it probable, that, in a greater depth, the tin will be followed by ſilver, as is commonly the caſe in the neighbouring mines of *Saxony*.

Theſe veins are called ſilver-veins, in reſpect to the ſilver which is contained in the lead-ore; and beſides them many tin-mines are working in the ſame mountain, but to no great advantage. I examined one of them, called the *Sweif*, in which they work on thin *ſoaring tin-veins* or *fiſſures*, which in reſpect to their flat and ſoaring extenſion greatly reſemble the larger ones at *Zinnwald*, being like them croſſed by many vertical or dipping veins, cut off or alter'd in their ſituation, and accordingly worked and purſued on the ſame principles.

They are in nothing different from thoſe at *Zinnwald*, except in their thinneſs and in their want

want of ſkirts, being immediately grown to the ſides of the country or rock, in which they are running. They conſiſt in their whole width of ſolid *tin-ſtone*, and it is very rare to meet any quartz in them, which makes them bear the expence of working, although their width is ſcarce ever above half an inch. The beds or lamellæ of the gneiſs-rock in the country, on both ſides of the veins, are moſtly vertical or ſtanding upright. The ſoaring veins, if cut off or croſſed by vertical ones, produce large joints or riders of tin-ſtone up and down in the vein. It would be worth euquiring whether theſe vertical veins contain any ſilver; but the miners in this place do not know nor care for any other than tin-ſtone. It is remarkable, that the ſurface of the mountain ſinks and falls in the ſame direction, as the ſoaring tin-veins are raiſed or ſunk by the croſſing vertical veins.

From the top of this mountain the whole country or valley of *Maria-Schein* and *Toplitz* appears before you. It is covered by many gentle incumbent hills or flats, which are interrupted by ſome inſulated conic ſteep granite-mountains, for example near *Muhlſhaw*, where a ſteep chain of granite-rocks riſes above the ground, and ſhows to the cooleſt imagination, that the mountains at

Graupen

Graupen have been formerly the ſhore of a ſea, which covered the valley of *Maria-Schein*, and above which the inſulated granite-cliffs at *Muhlſhaw* muſt have once appeared.

Muckenburg *or* Muckenthurmel.

FROM the before mentioned old mines in the *Knutler-Gezirck* I purſued that aſcending ſlope of the mountain to another line of old mines, which is called the *Altenberg*. I paſſed near *Creuzgang* and *Manſuetus*, which are ſtill working on larger tin-veins than thoſe at *Schweif*. Though five workmen are only employed in *Creuzgang*, the dividend however in 1767 conſiſted of 1400 florins, which greatly vouches for the riches of the mountain.

Hence it aſcends rapidly towards *Muckenthurmel* or *Muckenberg*, where they have in gneiſs ſunk a ſhaft on a large copper-vein, which they conſider to be a *ſtockwork*. Here is the higheſt point of theſe mountains, many hundred fathoms above the valley of *Toplitz*; and hence they ſlope and ſink towards *Altenberg* in *Saxonia*. *Gneiſs-rock* continued to *Furſtenaw*, where a variety of granite

granite appeared, which beyond *Geiſing* at *Altenberg* had its common and natural colour and mixture.

Ratieborziz *or* Bergſtedt, *in the Circle of* Tabor.

THE ſilver-mines in this place are the property of Prince *Swarzenberg*. They are in gentle hills and grey or blueiſh clay-ſlate; in which are obſerved ſome fiſſures of greeniſh lithomarga, or half-indurated pot-ſtone earth or bacon-ſtone. A variety of veins, which croſs thoſe mountains, are worked to advantage.

Count *Kienburg*'s works at *Rzemizow*, a vein which is parallel to that at *Ratieborziz*. To the weſt of this place Cardinal *Migazzi* has a ſilver-mine. The old mines at *Tabor*, which were formerly ſo rich of native-and redgilder-ore, have been of late taken up again by Baron *Keſler*. Near *Budweiſs*, and near *Rudolph* and *Adamſtadt*, are many conſiderable old mines in different mountains, which are working partly by Her Royal and Imperial Majeſty, partly by the citizens at *Budweiſs*, and partly by prince *Swarzenberg*. They

They have of late found dendritical native ſilver at *Budweiſs*.

The mines at *Ratieborziz* or *Bergſtedt*, which belong to the prince of *Swarzenberg*, have been taken up again in 1719. There are ſeveral of them. 1. The *Chief-mine* or *Haupt-Baw* at *Bergſtedt* conſiſts of *Lawrence*, *Charles*, *Michel* and *Nichols*, which are drained by *S. John's* gallery or the deepeſt water-level. The veins are *S. Nichols* and *Charles*; both northern veins, or running from north to ſouth, and dipping in about ſixty degrees. *S Nichols* dips to the eaſt; *S. Charles* to the weſt. Where richeſt, they are about three inches; where yielding ſprinkled and mixed ore, they are about two feet. The deepeſt ſole is at preſent ſeventy fathoms vertical under ground. About fifty fathoms to the weſt, and in a direction parallel to their's, runs a foul vein twenty-five fathoms wide, which conſiſts of mixed, white blue and yellow clay, and cuts off the croſſing ramifications, which diverge from the chief veins in ſuch a manner, that hitherto they have not been hit again beyond it.

2. The under-work near *Bergſtedt*, purſues a vein which runs between hour two and three, and has lately yielded rich ore in the *S. Anthony-ſhaft*, It contains lead-glance with ſilver, and that ſort of ſpecular blende which ſhall be ſpoken of

of hereafter. Where the rock ſoftens and is mixed with quartz, there is likewiſe native ſilver.

3. *Dorothea*-mine and *S. George's gallery* are to the weſt of *Bergſtedt*, for the preſent extremely rich, and work on two veins, which have united. One is called *S. George*, runs in hour two; the other is *Dorothea-vein*, which diverges from the former in the hanging runs in hour twelve. This was formerly exremely thin, ran in hard rock, and contained roſy-coloured feldſpath, with ſome lead-glance blende and a little ſilver; but as ſoon as a joint with miſpikkel came into the hading, the vein produced white-and red ſilver-ore, native ſilver and glaſs-ore. *S. George* has in reſpect to *Dorothea* an irregular dipping, becauſe it coincides or unites with it in the depth. As long as it continues running by itſelf, it is ſo much cut by foul clay-veins, that it produces but little and poor lead-glance and blende.

4. *Old-Woſchiz-Hope God's Bleſſing-Gallery* was quick already fourteen years ago. They work here on a vein, which runs between hour nine and twelve, and dips between forty-five and ſeventy-five degrees. It is from two inches to one foot wide, and richeſt where thinneſt. It is chiefly quickened by the coming-in of a winding undulating black clay fiſſure, which appears ſometimes in the hanging; then

then it produces fallow, white-and red ſilver-ore. It is likewiſe croſſed by ſome morning or eaſtern-veins, which affect it in a different manner; ſince, before they croſs it, the vein appears cut off and dead, till, beyond the croſs, it appears quick again in the former run; ſometimes the ore and the vein are entirely loſt or hid under the croſs-joint, fall out extremely rich underneath it, but diſappear entirely above it.

Three hundred and fifty men, the waſhers and ſmelters included, have here employment.

The gang or vein, or the metallic matrices in theſe veins are,

1. Fine white quartz partly tranſparent, partly cryſtalliſed. Some cryſtalliſations are lamellous, having on the under part ſquare regular impreſſions, as in the cryſtalliſations from *Hodriz* near *Shemniz*.

2. White calcareous ſpar, variouſly tranſparent and cryſtalliſed.

3. Yellow tranſparent calcareous ſpar, cryſtalliſed like combs.

4. Reddiſh feld ſpath, remarkably found.

5. Clay, black, grey, and yellow.

6. Aſbeſt like cork, in whitiſh, thin and flexible lamellæ.

7. Miſpikkel or white arſenical pyrites, quickens the vein.

8. Sulphurous

8. Sulphurous pyrites occurrs now and then.

The ſilver-ores contained in theſe matrices are,

9. Native ſilver, like wire or hairs, commonly on miſpikkel or on yellow cubic ſulphurous pyrites.

10. Red-ſilver-ore, found and cryſtalliſed, tranſparent like ruby.

11. Glaſs-ore, found, cubic, and capillary.

12. White ſilver-ore.

13. Lead glance mineraliſed with ſilver, coarſe or fine, cubic or polyedrous.

14. Brown or red blende, knotty or cryſtalliſed, contains much ſilver.

15. Specular blende, yellow or greeniſh, lamellous and tranſparent, occurrs in large lumps, now and then under a cryſtalliſed form; broken, it conſiſts of large lamellæ, which reflect the light like mirrors. It is extremely rich of ſilver.

The waſh-and pounding-mills have nothing particular. But the above blende, containing much ſilver, and being for that reaſon ſmelted with the other ores, makes the ſmelting ſomewhat difficult. The medium of the ſilver-produce of theſe mixed ores is from 40, 50, to upwards of 100 ounces per hundred weight.

THE END.

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